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Japan Report

SCIENCE AND TECHNOLOGY

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JAPAN REPORT

SCIENCE AND TECHNOLOGY

CONTENTS

AGRICULTURAL DEVELOPMENTS, DEMAND, ECONOMY DISCUSSED

Tokyo NOGYO KYODO KUMIAI in Japanese Aug 85 pp 64-72

[Text] Introduction

Technical development is the prime mover in societal and economic advances. New technologies play important roles for the vitalization of the society and economy through the formation of new industries and promotion of productivity. Biotechnology, in particular, is considered to be a fundamental and leading technology which will flourish in the 21st century. From the agricultural viewpoint, it is an important technology for vitalizing farm production.

The development of agricultural biotechnology will influence the trends of future farm production and the business of the systematic agricultural cooperative society.

In this report, the requirement of biotechnological development will be discussed based on its potential market scale, trends, and backgrounds of R&D.

Potential Demand of Biomarket and Economy of Agricultural Biotechnology

Recently, the progress of what is called life science, that is, molecular biology and molecular genetics, has developed a series of biological techniques (gene recombination, cell fusion, etc.) which have enabled scientists to apply biological functions to the production of useful materials. New industries which use biological techniques will be created, and traditional industries vitalized.

The biological techniques will be used not only by chemical industries, but also fermentation, mine, and resource-energy industries. In the foreseeable future, a new industrial group, called "bioindustry," which will use basically biological functions, will be created.

As mentioned above, biotechnology is very widely applicable, and has power to influence the industries and have an impact on the national economy.

How large a scale is expected in the future with regard to the economic impact of biotechnology? Last December, the Bioindustry Development Center of the

Japan Association of Industrial Fermentation (BIDEC) conducted a survey on this subject. In this survey, technical trends are forecast in all industrial areas where biotechnology will be introduced. The direct effect of the introduction of biotechnology is expressed in the change of medium investment coefficients, and estimates are made of the market scale for bioindustries in the 21st century.

According to the survey, bioindustries in Japan are estimated at Y127.2 trillion, or 12.4 percent of GNP, among which the potential market scale brought about by biotechnology is estimated at Y15 trillion (Figure 1-1). While the value added productivity of the traditional techniques and biotechnology are 35.6 percent and 42.0 percent, respectively, the development of new biotechnology will promote the value-added productivity of the related industries (Figure 1-2).

Looking toward the 21st century, the potential market scale of biotechnology is very large. New industrial groups will be formed, and high value added to the related industries. In other words, the effects on economy brought about about by biotechnology will be very high.

The Progress of Agricultural Biotechnology and Its Effects on the Economy

Agricultural biotechnology will also progress remarkably in the 21st century, which in turn will have tremendous economic effects on agricultural production. Here again, the economic possibilities and impact of biotechnology in agricultural related fields are discussed based on the results of the survey conducted by BIDEC. The agricultural fields mentioned here are limited to the items shown in Table 1.

According to Table 1, the biotechnological market is expected to reach Y3.0243 trillion by the 21st century, 17.1 percent of all products. This is higher than the percentage of the biotech market in all other industrial markets, 12.4 percent, and shows that the economic effects of agricultural biotechnology are more pronounced than in other industries. Further, the percentages of the biotech market of agricultural products relative to all bio-applied products is 21.6 percent, which shows agricultural products have a larger potential market scale than other products.

The breakdown shows that crops (farm products, fruits, vegetables), with a value of Y1.401 trillion, the approximate value added is Y1.038 trillion; for the livestock industry, with a value of Y473 billion, the approximate value added is Y148 billion; and others with a total value of Y1.037 trillion, the approximate value added is Y241 billion. In every area, a potential market of over Y100 billion is estimated, and the value added yield is also estimated at nearly the same as other industries.

The breakdown by agricultural departments shows that rice and wheat have the largest market scale in biotechnology, followed by farm products like flowers, dairy products, and vegetables. Judging from these results, the economic impact brought about by agricultural biotechnology is high in major grains such as rice and wheat.

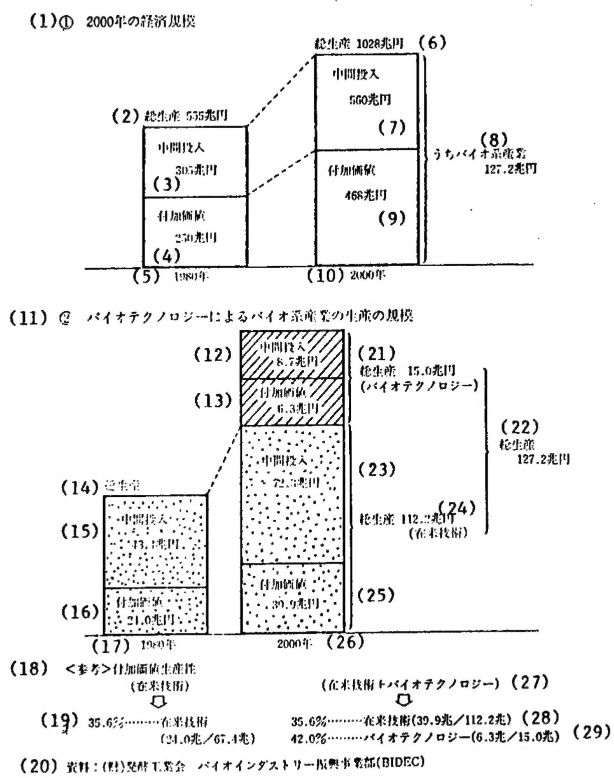

Figure 1. Economic Impact of Biotechnology in Japan

Key:

1. Economic scale in the year 2000
2. Total products Y555 trillion
3. Intermediate investment Y305 trillion
4. Value added Y250 trillion
5. 1980
6. Total products Y1,028 trillion
7. Intermediate investment Y560 trillion
8. Biological industries Y127.2 trillion
9. Value added Y468 trillion
10. The year 2000
11. Production scale of bioindustries through biotechnology
12. Intermediate investment Y8.7 trillion
13. Value added Y6.3 trillion
14. Total products
15. Intermediate investment Y43.4 trillion
16. Value added Y24.0 trillion
17. 1980
18. (Reference) Value added productivity (traditional techniques)
19. 35.6 percent....traditional techniques (24 trillion/67.4 trillion)
20. Data from Japanese Association of Industrial Fermentation, Bioindustry Development Center
21. Total products Y15 trillion (biotechnology)
22. Total products Y127.2 trillion
23. Intermediate investment Y72.3 trillion
24. Total products Y112.2 trillion (traditional techniques)
25. Value added Y39.9 trillion
26. The year 2000
27. Traditional techniques + biotechnology
28. 35.6 percent....traditional techniques (39.9 trillion/112.2 trillion)
29. 42.0 percent....biotechnology (6.3 trillion/15.0 trillion)

On the other hand, a comparison of the contributions of each category shows that nonedible farm products like flowers are the largest; the progress of technical development will evolve in nonedible farm products.

Table 2 details the techniques which will be applied to these categories and also the time frame when they will be applied. According to the table, agricultural biotechnology applied in the near future will include mass production of seedlings by tissue culture, the transplant of fertilized eggs of cows, and bioreactors. Agricultural biotechnology will focus on these three areas, and nonedible farm products.

Summing up the above, agricultural biotechnology has a relatively large potential market, with the economic impact largely in mass produced crops. As for the spread of technology, those which have developed to the application stage will be used for production. The techniques will initially be applied to nonedible farm products which have a higher value added.

R&D Strategies on Biotechnology in System Agricultural Cooperative Society and Others--Private Industries Advancing to Agricultural Biomarket

With the progress in agricultural biotechnology, numerous private industries have started R&D on agriculture-related areas which are considered to have a large-scale potential market.

What industries in Japan are developing biotechnology, and what areas are they aiming at? There is an example to introduce here. In "The Study Group for New Techniques in Breeding," established jointly by the Ministry of Agriculture and Forestry and biorelated industries, 15 industries--Mitsubishi Chemical Industries, Ltd., Mitsui Toatsu Chemicals, Inc., Kirin Brewery Co. Ltd., Suntory Co. Ltd., Kagome Co. Ltd., Kikkoman Corp., Kyupi Co. Ltd., Kyowa Hakko Co. Ltd., Meiji Seika Kaisha, Ltd., Ajinomoto Co. Inc., Asahi Chemical Industry Co., Ltd., Teijin Ltd., Mitsui Petrochemical Industries, Ltd., and Sekisui Chemical Co. Ltd.--participate and exchange information between government and private sectors.

Among the 15 companies participating, five have already started R&D in breeding; the others plan to start in the near future. As for breeding products, there are: five vegetables, two beer barleys, two flowers, and two fruits.

In regard to the products which they intend to develop in the future, five companies each plan to develop rice plants and soybeans; three companies will develop wheat, flour, and corn. Many companies intend to develop grains.

The common areas of interest of these companies are that they currently breed horticultural products such as flowers and vegetables, but future products are to be rice plants and wheat, taking into consideration overseas markets. Their ultimate target will be grains which have large economic impact.

Methods to be used for breeding include: gene recombination (nine companies), cell fusion (thirteen companies), and tissue culture (two companies).

Table 1. Economic Impact of Agricultural Biotechnology in 2000

(Unit: billion yen, percent)

	Name of Departments	Amount of Products	Biotechnology Products	Rough Value Added	Rough Value Added by Biotechnology	Growth Rate (Average Growth Rate, Percent)	Contribution Rate of Biotechnology (Percent)
General Farm Products	Rice, wheat	5,462	519	4,009	381	1.5 (1.93)	33.5
	Vegetables	2,593	257	1,882	164	1.6 (2.45)	27.1
	Fruits	1,107	13	726	9	1.4 (1.80)	5.3
	Potatoes	418	13	237	8	1.7 (2.59)	10.7
	Farm products for animal feed	182	2	117	1	1.7 (2.71)	2.7
	Leaf tobacco	293	12	216	9	1.2 (0.85)	28.1
	Nonedible farm products	636	494	515	400	1.8 (2.85)	153.8
	Others	614	91	444	66	1.7 (2.54)	43.5
Livestock Industries	Dairy farming	1,318	327	444	111	1.7 (2.57)	68.1
	Products of beef cattle	642	146	161	37	1.7 (2.71)	61.4
Other Related Areas	Assorted feed	2,128	637	194	58	1.6 (2.28)	85.6
	Dairy products	2,209	590	561	150	1.5 (2.11)	81.3
	Chemical fertilizer	875	0	214	0	1.4 (1.82)	0.0
	Agricultural chemicals	472	142	111	33	1.4 (1.55)	111.8
	Total	18,943	3,243	9,831	1,427	-	-

Data produced from survey by Japanese Association of Industrial Fermentation.

(Note) Amount of money is estimated in 1980. Inflation rate not taken into consideration.

However, a long period of time is required for the application of breeding techniques, and therefore companies are developing herbicides, insecticides, plant hormones, artificial seeds, and dwarfing agents simultaneously. Moreover, 10 companies suggested that cooperation is necessary in order to advance current techniques.

Thus, constructive attitudes and cooperation can be seen in the active development of agriculture using biotechnological techniques.

In short, biorelated industries plan to focus on biotechnology development in areas which can be completed in a relatively short period to cooperate between companies when necessary, and finally to promote the agricultural biotech market.

Development of Biotechnology by Agricultural Cooperative Society

As mentioned above, the biotech market with its high potential is being led by private companies employing long term strategies. On the other hand, the R&D by the system agricultural cooperative society has just begun.

However, some unit agricultural cooperative societies and farmers have been conducting their own unique research and development for applying biotechnological techniques. For instance, Tokachi Agricultural Cooperative Society in Hokkaido is developing nitrogen fixation of rice plants, and has been conducting other very high-level research; carnation producers in the south division of Okita Agricultural Cooperative Society in Nagano Prefecture are engaged in apical meristem culture, which is an example of producers themselves conducting R&D on biotechnology. In Naegi Agricultural Cooperative Society in Tanushi mura-cho, Fukuoka Prefecture, orange seedlings are produced by meristem culture and sold to the farmers.

Meanwhile, a private farmer in Iijima-machi, Nagano Prefecture has succeeded in the breeding of "Hakatayuri" and "Sasayuri" by tissue culture, and grew the seedling of a perennial plant, Kasumiso. Some other farmers are also conducting advanced research by themselves.

As mentioned in the previous paragraph, there are many private researchers in biotechnology in the system agricultural cooperative society, but they are not officially recognized as researchers or research groups. Private farmers and unit agricultural cooperative societies are actively engaged in the development, which is one of the characteristics of biotechnological research in the system agricultural cooperative society.

Why Biotechnology Is Necessary for the System Agricultural Cooperative Society

Although the development of biotechnology has very large potential demand, there are many technical problems to be solved, and long-term research is required. If you forecast for the 21st century, you will find that biotechnological development is a very important issue for the system agricultural cooperative society.

Table 2. Future Prospects of R&D on Cell Fusion, DNA Recombination, Cell Culture

Products of R&D	Time of Application		
	1980's	1990's	21st Century
I. Cell Fusion			
1. Introduction of useful characteristics to farm products			
a. Solanaceae, Cruciferae, Oenanthe javanica, Seaweed, Chlorella		X	
b. Rice plant, forest			X
2. Nitrogen supply of farm products by microbes and blue-green algae	X		
3. Mass-production of monoclonal antibodies for diagnosing livestock diseases.	X		
II. Combination of Cell Fusion and DNA Recombination			
4. Enhancing ability of nitrogen fixation bacteria		X	
5. Enhancing production ability of proteins for animal feed by microbes		X	
6. Effective production by microbes of amino acids, enzymes, vitamins, physiologically active substances	X		
7. Effective energy production by microbes			
a. Alcohol production from various biological sources		X	
b. Methane production from various wastes	X		
8. Effective recovery of harmful substances such as heavy metals, and decomposition of organic substances by microbes		X	
9. Purification of water in lakes and marshes by microbes			X
III. DNA Recombination			
10. Introduction of useful characteristics into cells of crops, wood, livestock, fishes, microbial natural enemies, and insects			X
11. Provide nitrogen fixation ability to crops			X
12. Production of vaccine, growth hormones for livestock and fishes	X		
IV. Tissue Culture: Cell Culture			
13. Mass Production of clone plants and seaweed by tissue culture	X		

[Table 2 continued]

Products of R&D	Time of Application		
	1980's	1990's	21st Century
14. Production of edible pigments and flavor by cultured plant cells	X		
15. Use of cultured animal cells			
a. Mass-production of virus natural enemies by cultured animal cells			X
b. Effective production of useful substances by cultured animal cells	X		
V. Manipulation of Eggs			
16. Production of superior livestock by transplantation of fertilized eggs, or artificial polyembryony	X		
17. Production of clone livestock by nucleus transplant		X	
VI. Use of Enzymes			
18. Use of bioreactors			
a. Effective production of sugars, organic acids, nucleic acids, agricultural chemicals with use of bioreactors	X		
b. Effective saccharification of nonsoluble substances like cellulose		X	
19. Development of biosensors			
a. Effective control of food quality by biosensors using immobilized enzymes	X		
b. Development of biosensors by using complicated biological functions		X	
VII. Use of Biological Abilities			
20. Formation by microbes for feed, food materials, and fuel alcohol from unused or rarely used biological resources	X		
21. Effective use of decomposable organic soil substances, and protection from diseases by equilibrium of soil microbes			X
22. Promotion and maintenance of desirable environments by using highly sensitive substances		X	

Data: From the Association for the Development and Application of Biological Resources in the Ministry of Agriculture, Forestry, and Fisheries

The ultimate objective of the biotechnological development for private industries is profit, and most of the profit will go to private industries. At present, private sectors lead technological development, and it can be easily imagined that the profit which will be passed on to farmers will be very small, if the technical development in the future is taken into consideration.

Currently, private farmers and unit agricultural cooperative societies are very much interested in biotechnology. Suitable technical instructions are essential during the processes of technical promotion in order to combine technical and managerial innovation. Steady development by a local area such as the private farmers and single agricultural cooperative society should be taken into consideration as a strategy for biological R&D in the system agricultural cooperative society, and technical instructions should also be included in the development.

As a whole, the development of biotechnology has considerable effects on the foundation of future agricultural production. It is regrettable that the fundamental R&D in agricultural production, which supports human lives and secures the nation's food, is considered as a means to pursue profit. In the future, long-term, comprehensive strategies will be required more and more from the government as well as agricultural cooperative societies.

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CURRENT STATUS, OUTLOOK FOR ELECTRONICS INDUSTRY

Tokyo DENSHI KOGYO GEPPO in Japanese Aug 85 pp 2-15

[Article by Yoshinori Kobayashi, assistant director for secretary section of Japan Development Bank (vice chairman for Industrial Research Special Committee): "The Current Status and Outlook for the Electronics Industry"]

[Text] Introduction

The Industrial Research Special Committee has investigated the structural analysis for the industrial characteristics (engineering, investment, and specialization structure), internationalism, and the growing nature of the electronics industry with specific attention to the strategic nature of the electronics industry. Since previous investigations, the environment of the industry has changed dramatically, and at the same time the electronics industry itself has been forced to change its nature to a large extent. Since the oil crisis, the industrial structure of Japan has been continuously and dramatically converted from the previous energy-intensive or labor-intensive industry into the resource-reduction or energy-saving industry.

Electronics technology which features energy reduction, nonpublic hazard, miniaturization, and higher performance has had an extensive impact on every industry, thereby changing the industry and creating a new industry which has not existed before. The electronics industry is now playing a central part in upgrading the industrial structure based on the nature of its technical frontier, as well as the spreading effects of greater technical and economical impact, and it is expected to maintain its status as one of the very few leading industries which can keep up its current high growth rate. Indeed, the electronics industry is considered a strategic industry which can have a great impact on the development of a high information society which is expected to grow full-scale in the near future.

The future trend of the electronics industry will greatly affect the economy of our country. Our special committee is now analyzing the role of the electronics industry, which is currently being converted into the high information society, and the outlook for the future in terms of both theory and corroborative evidence. The committee also places particular attention on the analysis of the current status based on the dynamic nature of the electronics industry which cannot be found in the other industries. Furthermore, our committee is also trying to understand what policy the developing

countries are currently adopting toward their own electronics industry, with specific attention to the differences in their industrial levels, at the same time trying to carry out the overall investigation of the electronics industries of foreign countries (including the socialist countries and China). The topics in the investigation report of our special committee are arranged as follows:

The Current Status and Outlook for the Electronics Industry

1. The Current Status and Trend of the Electronics Industry in Japan

1.1 The Current Status of the Electronics Industry in Japan
1.2 The Characteristics of the Electronic Industry
1.3 The Internationalization of the Electronics Industry

2. The Outlook for the Electronics Industry

3. The Electronics Industries of Foreign Countries

1. The Current Status and Trend of the Electronics Industry in Japan

1.1 The Current Status of the Electronics Industry in Japan

(1) When viewing the current position of the electronics industry as it affects the machinery industry, production of the electronics industry was not 20 percent of the production of the machinery industry in 1978 after the oil crisis; but by 1983, it shared 26 percent of the production of the machinery engineering world, outstripping the automobile industry. In terms of export, the electronics industry has attained a growth rate of more than 20 percent for the past 5 years. The electronics industry increased its share in the machinery industry to 24 percent in 1978 and 32 percent in 1983.

Table 1. Production of Machinery Industry

	1978		1983	
Division	Sum (Y100 million)	Component ratio (percent)	Sum (Y100 million)	Component ratio (percent)
General machinery	68,438	20.5	89,751	18.3
Electric machinery	102,499	30.6	171,495	34.9
Electronic machinery	63,787	19.1	126,848	25.9
Transportation machinery	113,406	33.9	166,501	34.0
Automobile	81,846	24.5	121,959	24.9
Precision machinery	10,423	3.1	11,817	2.4
Others	39,935	11.9	50,766	10.4
Total	334,701	100.0	490,330	100.0

Table 2. Export of Machinery Industry

Division	1978		1983	
	Sum (Y100 million)	Component ratio (percent)	Sum (Y100 million)	Component ratio (percent)
General machinery	22,890	21.0	41,552	19.9
Electric machinery	33,802	31.1	72,041	24.7
Electronic machinery	26,391	24.2	65,926	31.7
Transportation machinery	42,079	38.7	77,749	37.4
Automobile	32,647	30.0	60,790	29.2
Precision machinery	9,840	9.0	16,379	7.9
Others	219	0.2	117	0.1
Total	108,830	100.0	207,838	100.0

Table 3. Research Expenditure Per Industry Classification

(Unit: Y1 million)

Industry / FY	1978	1979	1980	1981	1982	Component ratio (1982)	Growth rate 1982/1978
Entire industry	2,291,002	2,664,913	3,142,256	3,629,793	4,039,018	100.0	15.2
Manufacturing industry	2,098,740	2,447,099	2,895,571	3,374,224	3,755,536	93.0	15.7
Food	61,515	67,803	90,237	92,207	104,944	2.6	14.3
Textile	24,277	32,860	34,209	64,453	51,869	1.3	20.9
Pulp/paper	13,572	14,235	15,924	15,826	19,636	0.5	9.7
Publishing/printing	6,086	4,995	5,735	4,826	8,063	0.2	7.3
Chemical	404,208	489,829	558,252	617,354	687,493	17.0	14.2
Petroleum/coal product	24,886	26,024	64,906	40,564	43,582	1.1	15.0
Rubber product	42,991	45,692	50,880	52,415	55,782	1.4	6.7
Ceramic industry	58,415	72,895	83,222	84,100	93,608	2.3	12.5
Steel manufacturing	107,921	119,992	147,064	169,653	182,772	4.5	14.1
Nonferrous metal	34,415	39,571	54,959	67,663	72,055	1.8	20.3
Metal product	39,948	54,568	52,027	64,623	64,834	1.6	12.9
Machinery industry	160,535	185,749	218,877	242,096	281,024	7.0	15.0
Electric machinery industry	580,521	694,212	817,224	1,006,225	1,176,356	29.1	19.3
(1)	266,975	311,524	281,240	341,918	385,769	9.6	9.6
(2)	313,546	382,688	535,984	664,307	790,583	19.6	26.0
Transportation machinery	404,155	445,614	510,454	627,433	671,923	16.6	13.6
Precision machinery	69,195	77,231	99,338	126,762	134,239	3.3	18.0
Other industries	66,100	75,829	92,263	98,025	107,356	2.7	12.9

(Source: Science and Technology Research Report prepared by Prime Minister's Office)

Key: (1) Electric machine and equipment industry
(2) Communication/Electronic/Electric instrument

Table 4. Analysis of Depression Effect Degree in Manufacturing Industry

(Unit: Y100 million)

	First oil crisis				Second oil crisis			
	1970-74	1974-75	Impact	Industry scale 1974	1978-80	1980-81	Impact	Industry scale 1981
Production increase in manufacturing industry (annual rate)	13,189	Δ4,201	17,390	--	23,041	4,475	18,566	--
Steel manufacturing								
Production increase	1,395	Δ 946	2,341	--	2,191	298	1,893	--
Component ratio	10.6	22.5	13.5	10.5	9.5	6.7	10.2	8.4
Petrochemical								
Production increase	1,830	50	1,780	--	5,481	45	5,436	--
Component ratio	13.9	1.2	10.2	10.5	23.8	1.0	29.3	13.0
Automobile								
Production increase	979	1,020	Δ 41	--	2,453	368	2,085	--
Component ratio	7.4	24.3	Δ 0.2	8.1	10.6	8.2	11.2	12.4
Electronics								
Production increase	512	Δ 551	1,063	--	2,051	1,319	732	--
Component ratio	3.9	13.1	6.1	5.6	8.9	29.5	3.9	8.7

(Prepared based on Industrial Statistical Table)

This dramatic growth is based on the continuous appearance of new products from technical breakthroughs, which results in improvement in cost performance, and the technical innovation-oriented market extension. In other words, the positive investment in research and development in the industry may be cited as the principal factor for the dramatic growth of the industry. The investment in research and development expenditures for the electronics industry has reached 20 percent, indicating a dramatic annual growth rate of 26 percent, which represents a level of nearly 5 percent of the ratio of growth to sales amount, ranking next to the pharmaceutical product industry. The Japanese economy has gone through an oil crisis twice, which has had a great impact on the industrial structure of our country, and produced a marked imbalance in all industries, dividing it into a slumped raw material-based industry and a prosperous manufacturing industry. In the meantime, the electronics industry has exhibited a relatively satisfactory business performance. This report has computed "degree of depression resistance" and measured the degree of influence affected by the depression of each major industry. This clearly indicates that the degree of influence (15 percent) affected by the first oil crisis is greater than that (10 percent) affected by the second oil crisis. The steelmaking industry and the petrochemical industry was subjected to a relatively greater influence, while the electronics industry was less subjected. From the standpoint of the industrial scale, the industry is more subjected to the influence of the oil crisis, as the scope of the industry is increased. As seen from Figure 1, the electronics industry exhibits a right-downward trend on the contrary, is less subjected to the depression, even if the industry is increased in scale.

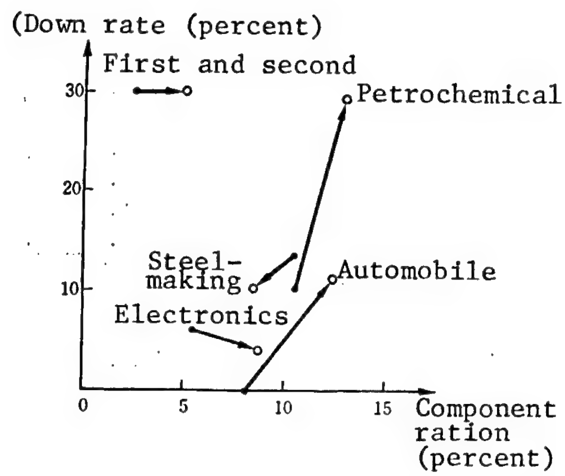


Figure 1. Resistance Degree Against Depression According to Industrial Classification

(2) One of the main factors which has accelerated the development of the electronics industry is the electronization of equipment. The innovation of the basic technique represented by IC has supported the dramatic progress of the electronization. This investigation focuses on the IC industry which holds the key to the development of the entire electronics industry in the

future, and quantitatively analyzes the structure of its growth. In this report, the author would like to summarize the framework of the analysis and the outcome.

The three growth factors of IC are classified as follows: 1) the growth of set equipment market; 2) the growth of IC ratio applied for the set equipment, and 3) the change in the unit price. In this report, an attempt has been made, in particular, to quantitatively grasp the growth structure of the MOS IC market. As seen from the outcome of our assumption in Table 5, the IC factor dominates the other factors, and is followed by the set factor, which cancels the minus of the cost factor. The IC factor may be classified into two: 1) introduction of new IC's due to the electronization of set equipment which constitutes substitution demand by other components; 2) introduction of IC's having a new function due to the multifunctions of the set equipment itself, which constitutes new demand. Simple simulation, if carried out based on the models, will reveal that the trend of set equipment is the important key to the demand for IC's.

Table 5. Growth Factor Analysis of MOSIC (Unit: percent)

Item	1980-1979	1981-1980	1982-1981	1983-1982
(1) Growth degree of IC (sum)	56.8	6.1	32.6	67.9
Ⓐ Set factor	22.2	19.2	3.3	13.6
Ⓑ IC factor	43.2	12.1	34.6	44.2
Ⓒ Price factor	-10.4	-20.6	-4.7	2.5
(2) Growth degree of IC (quantity)	75.0	33.7	39.0	63.9
Ⓐ Set factor	22.2	19.2	3.3	13.6
Ⓑ IC factor	28.2	-10.9	28.3	47.8
Ⓒ Price factor	11.7	25.9	4.9	-2.4

Prepared based on the production dynamic state analysis by the Japan Electronic Machinery Industry Association and the Ministry of International Trade and Industry.

The regression analysis of the relation between these three factors clarifies that there exists a specific correlation between the demand growth and the three factors.

If the future electronics industry is reviewed based on the growth structure discussed above, it is expected that the application rate of IC components, which constitutes the greatest growth factor for the IC market, will be accelerated and the application percentage of higher functions and multifunctions based on the higher degree of integration will be dramatically developed, thus undergoing smooth changes. As for set equipment, the market trend is more critical than the application rate of IC components. For the present, the trend of VTR, which forms an important market for IC's together with computers, plays a decisive role, because the IC industry fluctuates

the demand for set equipment on a short period of time, and amplifies the fluctuations and has an impact on the IC market, as discussed earlier. An attempt to introduce IC's into the other industries has been continuously made, but the space of introducing IC components is slow. The full-fledged electronization of other industries can be highly expected in the future. When reviewing the outside environment surrounding the IC industry in relation with this, the two problems of trade friction and semiconductor supply are considered growth inhibiting factors, and such a trend is feared.

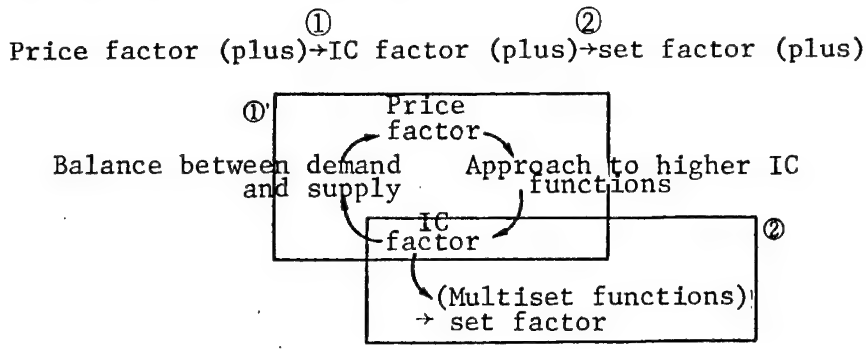


Figure 2. Correlation Between Each Factor

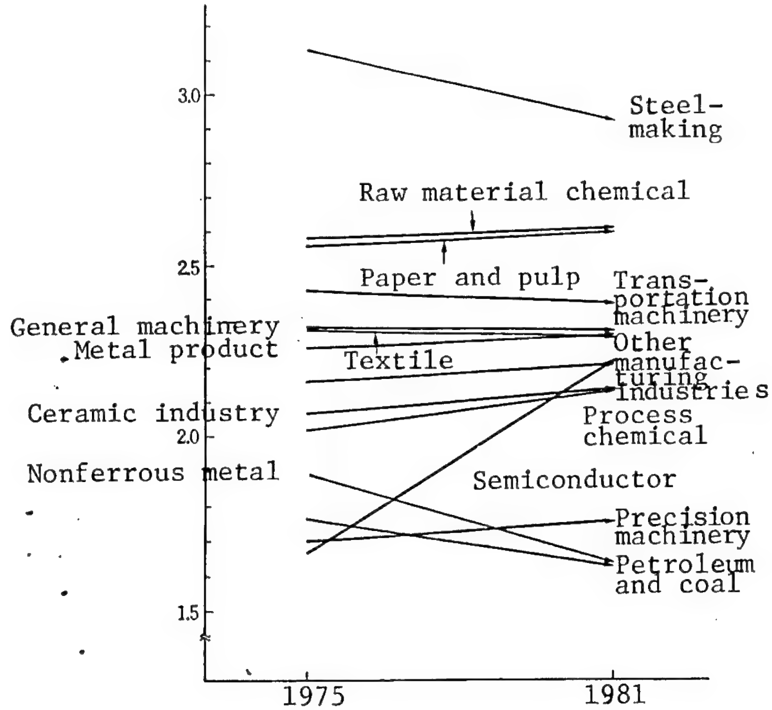
(3) The author also would like to review the influence that the growth of the IC industry exerts on other industries based on the analysis of the other industries. As seen from Table 6, the production induction factor for semiconductors is 0.926308, and is below the level of 1 due to the influx of imports, but the impact upon the other industries causes the factor to rise to 1.287996, indicating a considerably large value. The impact upon nonferrous metals (0.184113) and other manufacturing industries (0.131790) is especially great. It is inferred that this has induced the production of silicon, aluminum, copper, and gold to be used for materials or semiconductor manufacturing equipment.

In addition, when compared with other industries between 1975 and 1981, the spreading effects produced by the semiconductor industry shows conspicuously large values as seen from Figure 3. And the spreading effects are more marked when the semiconductor industry itself is included. This is because many computer-aided apparatuses are applied to produce semiconductors, and hence require more IC components. The phrase "semiconductors call for other semiconductors" explains well the background of this phenomon. When considering the "background-associated effects" (indirect effects) of semiconductors, where installation of semiconductors introduces a new product, thereby strengthening the competitive power of other industries, both direct and indirect effects of semiconductors are considered to be more conspicuous.

(4) The amount of production of the electronics industry in our country reached Y13,465,400,000,000 in 1983. In 1986, it exceeded the level of Y1 trillion, and Y5 trillion in 1976, finally topping the whopping Y10 trillion mark in 1981, thus exhibiting the wonderful progress of the Japanese electronics industry. When the details of this progress are examined, it will

Table 6. Production Induction Factor for Semiconductor Industry

	1975	1981
Primary product	0.039198	0.041697
Food	0.004742	0.005794
Textile	0.007248	0.010430
Paper/pulp	0.015060	0.025538
Raw material chemical	0.024150	0.043617
Process chemical	0.017032	0.022066
Petroleum/coal product	0.027537	0.056673
Ceramic industry	0.007021	0.013202
Steel manufacturing	0.033738	0.067968
Nonferrous metal	0.192101	0.184113
Metal product	0.042668	0.086795
General machinery	0.028048	0.075078
Electric machinery	0.005353	0.011895
Electronic communication equipment	0.001512	0.003579
Transportation equipment	0.008528	0.017139
Precision machinery	0.002495	0.002659
Other manufacturing	0.068594	0.131790
Construction civil engineering	0.003525	0.004910
Excluding electric power	0.034760	0.069815
Transportation	0.041416	0.085234
Commerce	0.068389	0.084573
Finance and insurance	0.050817	0.071519
Real estate	0.012319	0.017819
Lease	0.001939	0.004749
Communication service	0.068728	0.117163
Individual service	0.000554	0.000913
Public service	0.005321	0.008004
Total, excluding semiconductor	0.835031	1.287996
Semiconductor	0.835831	0.926308
Total	1.670862	2.214304



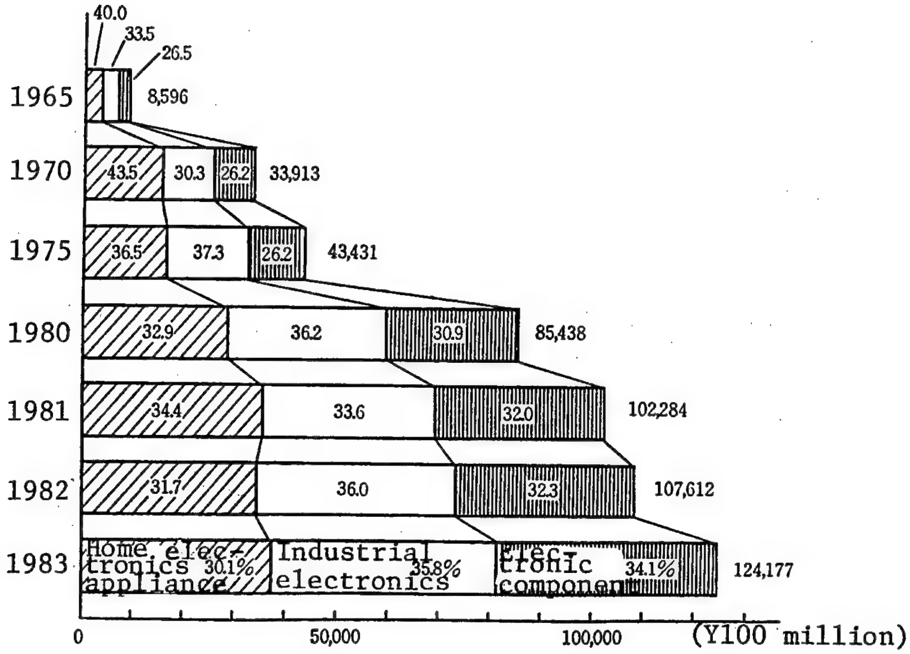
(Data) Based on "1975 Industry Associated Interface Table" and "1981 Industry Associated Extension Table" prepared by the Ministry of International Trade and Industry

Figure 3. Major Industry's Production Spreading Effects (Spreading effects including the industry concerned)

found that the Japanese electronics industry comprised 30.1 percent of home appliances, 35.8 percent of industrial equipment, and 34.1 percent of electronics components as of 1983, replacing the home appliances which played the leading role up to the latter half of the 1960's, with industrial equipment and electronics components, which currently plays the role of engine, vigorously pushing forward the development of the industry.

The author would like to discuss more controversial points, though all are minor:

(a) Home service: The average annual growth rate reached 14.2 percent in the 1960's, marking satisfactory progress, but was reduced by 50 percent in the subsequent years after 1975. (The average growth rate was only 7.6 percent during the period from 1976 through 1983.) This signifies that the protectionism movement of the advanced countries, the pursuit of the middle-advanced countries, and the absence of large-sized products should be responsible for the low growth rates. A greater expectation is placed on such large-sized products as video disk players, 8 mm video recorders, and digital disk players as the next large-sized products. As for the



(Source) Machine statistics prepared by the Ministry of International Trade and Industry

Figure 4. Change in Production Volume in the Electronics Industry

potential market for these products, China has latent gigantic demand for them, and the future growth trend can be highly expected.

(b) Industrial equipment: The production scale has been dramatically extended since 1965. It is expected that computers and associated devices, which form the majority of electronic application devices, will still continue their high growth in the future. In particular, personal computers and office computers have made more marked progress than general purpose computers, and the OEM supply of computer-associated devices, which are designed for the U.S. market, has been increased to a large extent. Coupled with the development of the information society, the field of communications equipment is also expected to make marked progress in subsequent years.

(c) Electronic components: Electronic components have dramatically increased their market share recently. IC's play the leading part in the development of electronic components. They marked a high average growth rate of 32.8 percent during the period from 1975 through 1983. Especially in the field of memory, Japanese technology excels that of the United States, and predominates the world market in the field of 256K DRAM.

(d) Software: Software production in Japan is estimated to mark 58 percent for general users, 16 percent for mainframes, and 26 percent for software houses. The production volume of software reached Y364,400,000,000 in 1983.

More than 90 percent of software production in Japan is designed for "custom made software," and a large amount of software is imported from overseas, which shows the current status of software in our country.

(5) Finally, the author would like to discuss the current status of import and export. The export of electronic equipment amounted to Y6,174,300,000 in 1984. The details for export are classified into 43.8 percent for home electronic appliances, 25.9 percent for industrial equipment, and 30.3 percent for electronic components, which indicates the current status of export in Japan. As seen from the above figures, home electronic appliances still play the leading part in the field of export. However, industrial equipment and electronic components have marked a higher growth rate in recent years. On the other hand, the amount of import reached Y631.2 billion in 1983, indicating an imbalance to a greater extent, compared with export. Industrial equipment marks 44 percent, while electronic components mark 56 percent, thus constituting the greater part of imports. Industrial equipment is centered on computers, while electronic components are centered on IC's.

Regarding the status of export based on the areas to be exported, in 1983 export marked 36.7 percent for the United States, 25.2 percent for Europe, and 20.8 percent for Southeast Asia. As can be seen from these figures, the U.S. market predominates the other markets. As for home appliances, the export marks 34 percent for the U.S. market, (Y929.5 billion), 31 percent for the European market, and 10.8 percent for the Southeast Asian market. Southeast Asia, which is going to be our export basis for home appliances, marks the low percentage of Japanese export. The export of industrial equipment to the U.S. market marked 47 percent or Y797.5 billion, and predominated other markets. Since it was mostly high tech-oriented products, there exists a potential chance for "trade friction." As for electronic components, Southeast Asia is our greatest export market. More specifically, the export to Southeast Asia amounted to Y790.5 billion, or 37.1 percent. Even in this field, there exist some potential trade friction problems centered on active components.

High tech-oriented products such as computers and integrated circuits imported from the United States amounted to Y454.4 billion or 66.5 percent, thus exceeding other products in terms of import. On the other hand, import from Europe marked only 9.7 percent, a quite low level.

(6) Japan's policy for the electronics industry

The electronics industry plays the most important part, not only as a strategic industry which upgrades the industrial structure and integrates information and knowledge, but also as an indispensable industry which assures and defends the national security. Therefore, the advanced countries are keenly interested in fostering the electronics industry, and are engaged in the development of the industry, thus involving state-to-state competition. In view of the strategic importance of this industry, Japan is now trying to arrange the competitive conditions and positively proceed with both indirect and direct support policies for the industry from the

standpoint that the market mechanism should be utilized to the maximum extent. The Japanese policy for the electronics industry may be roughly classified into three sections, when reviewed from the contents of the policy:

(a) Industrial infrastructure service policy based on the longer period and lower interest-oriented monetary policy;

(b) Direct support system based on subsidy; and

(c) Joint development system by government and private enterprise.

As the importance of developing the basis for both innovative and high technology is recognized more and more, it is expected that the development lag in this field will greatly affect the international competitive power of one country. Based on the above background, there is a growing recognition that the joint development policy of both the government and private enterprise should be the most effective development system.

To establish the technical development policy, Japan is urged to select the most effective method to combine (a) the power of the government, though suffering from financial restrictions, and (b) the vitality of private enterprise to carry out many-sided actions responding to the crossover and verified nature of the technical contents rather than the conventional individual actions. This signifies that Japan has demanded to change the previous policy, but also create a new philosophy.

1.2 Characteristics of the Electronics Industry

(1) It may be said that the technology of electronics is quite active to produce "production innovation." More specifically, electronics technology is not only innovating the contents of products themselves, but (a) also proceeding with product innovation in combination with product techniques in other industries, such as mechatronics. In addition, (b) it is forming a multiproduct small quantity and manufacturing system by introducing NC machine tools, and industrial robots, and (c) is cost effective in the overhead sections by introducing office automation (OA), and (d) is creating varied information service sections by using computers, thus producing spreading effects to a greater extent. It may be said that unlike the steel manufacturing, chemical, and automobile industries, which have grown based on "process innovation," the electronics industry has kept up its constant growth based on "production innovation."

Production innovation applied to the electronics industry has the following features:

(a) Smaller sized and higher degree of integration

Process innovation in the heavy chemical industry, such as the steelmaking and chemical industries, feature the larger- sized and larger-volume production system, while the electronics industry makes the greatest features of

smaller-size production. In particular, miniaturization of elements by introducing integrated circuits has made it possible to reduce the size as well as reduce the weight of equipment and systems which can perform the same functions as highly integrated silicon chips.

(b) Improvement in reliability and reduction in electric power

Improvement in product reliability and electric power saving can be attained by the miniaturization and high integration of products.

(c) Higher functioning and more systematic approach

As components and circuits are highly integrated on chips, thereby improving the degree of integration, IC's are being developed from a mere set of components or parts into one circuit unit or subsystem and finally into a system itself. This has extended the functions involved.

(d) Importance of software

The electronics industry manufactures a variety of products, but their popularity, especially that of information processing equipment and systems, are supported by the development and distribution of various kinds of application techniques other than hardware. This signifies that software becomes more essential to product innovation for the electronics industry itself.

(e) The importance of process innovation

The electronics industry is production innovation-oriented, but this does not necessarily mean that process innovation is not important for the industry. As a matter of fact, higher integration and mass production of IC's can never be attained without technical breakthroughs such as "micro working technique." The competitive power of Japanese IC products are ascribed to the well-balanced manufacturing technique and superior quality control technique, which clearly demonstrates that both product technique and manufacturing technique are inseparably related to each other.

(f) Larger-sized and more sophisticated facilities

The IC manufacturing facilities, if a higher degree of integration is required, will become larger-sized and more sophisticated and moreover greatly affect both the pre- and post-progress schedules. To recover huge investments in a short period of time, it is inevitable that the device should be larger-sized and mass production-oriented.

The economically well-balanced relation between the IC product technique and the IC manufacturing technique can be attained by the existence of a "learning curve." Dramatic progress in cost performance rapidly increases the demand for IC products, which creates a circulation of lower cost, mass-produced IC products.

The reason why the electronic technique has successfully developed such a wide range of application may be explained by the fact that the basic functions of the electronic technique cover "information functions" such as information transmission, information processing, measurement, and control. Current electronic technique has been developed exclusively on an information functioning basis. "Information functions" are committed by every action of human beings. This is one of the reasons why the applications for electronic technique are almost unlimited. Furthermore, the characteristics of the electronic technique are well suited to information functions.

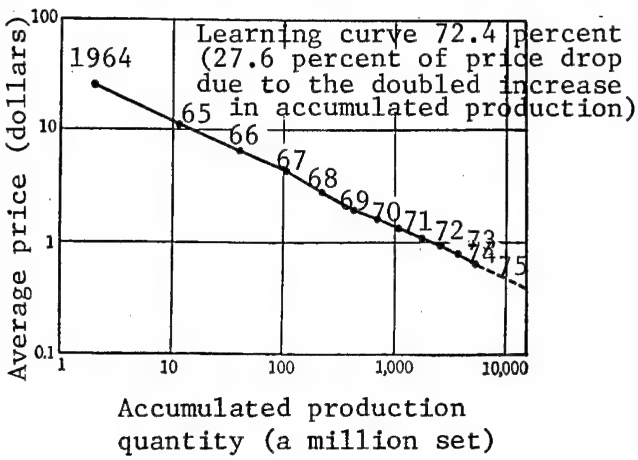


Figure 5. IC Learning Curve

In other words, the electronic is the most popular and minimum unit of substance which can be controlled by humans. The electronic technique, which assigns one bit of information to the minimum unit and thereby transmits information at the speed of electromagnetic waves, is the best means to transmit information which humans have attained.

The electronic technique, which is provided with such characteristics, may be assigned to a variety of characters or parts, depending on the application fields for information functions.

Since the waves of technical innovations based on the various electronic techniques are far reaching and deep, it is quite difficult to historically define their positions, although many attempts have been made before. Therefore, their current status is not defined yet. However, we are rushing into the "high information society" in the future whether we like it or not. This claims Japan's proper evaluation of the historical role of the electronic technique.

(2) Investment structure

The analysis of the research and development activities of the electronic technique, which are considered to most markedly reflect the chracteristics of the electronics industry, is attempted in this section.

Table 7. Plant Investment Trend for 1984

	Entire facilities investment			High tech-associated investment			
	1983 (A)	1984 (B)	$\frac{B}{A}-1$	1983 (C)	1984 (D)	$\frac{D}{B}-1$	$\frac{D-C}{B-A}$
Entire industry	136,609	150,939	10.5	25,792	33,858	22.4	56.2
(excluding lease industry)	118,246	130,184	10.1	13,842	20,382	15.7	54.7
Manufacturing	58,241	68,212	17.1	13,758	20,196	29.6	64.6
Nonmanufacturing	78,367	82,728	5.6	12,043	13,662	16.5	37.3
(excluding lease industry)	60,004	61,973	3.3	84	186	0.3	5.2
Raw material type	23,695	25,625	8.1	3,438	4,657	18.2	63.2
Textile	1,220	1,571	28.8	130	160	10.2	8.5
Paper/pulp	1,410	2,330	65.3	150	345	14.8	21.2
Chemical	8,017	9,436	17.1	2,500	2,900	30.7	28.2
Ceramic/clay and stone	2,074	2,539	22.4	306	505	19.9	42.8
Steel manufacturing	9,099	7,604	▲16.4	85	141	1.9	—
Nonferrous metal	1,875	2,145	14.4	267	606	28.3	25.6
Process/assembling type	31,154	38,966	25.1	10,320	15,539	39.9	66.8
Food	3,166	3,252	2.7	74	100	3.1	30.2
General machinery	3,167	4,338	36.9	1,160	1,900	43.8	63.2
Electric machinery	10,021	14,520	44.9	6,700	10,400	71.6	82.2
Transportation machinery	9,753	10,517	7.8	1,331	1,644	15.6	41.0
Other manufacturing industry	5,046	6,338	25.6	1,055	1,495	23.6	34.1
Energy	42,059	42,310	0.6	0	0	—	—
Electric power	35,397	35,489	0.3	0	0	—	—
Gas	2,481	2,489	0.3	0	0	—	—
Petroleum	3,393	3,621	6.7	0	0	—	—
Nonmanufacturing industry (excluding energy)	39,701	44,039	10.9	12,034	13,662	31.0	37.5
Construction	1,829	1,789	▲ 2.2	55	59	3.3	—
Wholesale/retail sales	4,611	4,823	4.6	23	15	0.3	—
Real estate	3,858	4,368	13.2	6	112	2.6	20.8
Transportation/communication	9,102	9,918	9.0	0	0	—	—
Service	19,978	22,906	14.7	11,950	13,476	58.8	52.1
(Lease industry)	18,363	20,755	13.0	11,950	13,476	64.9	63.8

(Note) High tech-associated investment partially includes estimation. This table is prepared based on the plant investment questionnaire of the Japan Development Bank.

(a) The investigation into the questionnaire to identify what position the electronics industry holds in the entire industry reveals that the investment rate of the electronics industry has been increased every year in the process of industrial structural change from raw material-oriented to process/assembly-oriented industry after the oil crisis. In 1983, the electronics industry shared 7.3 percent of all industry, thus dominating the other industries such as transportation equipment (7.1 percent), steel manufacturing (6.7 percent), and chemical (5.9 percent).

(b) When the growth rate of the electronics industry is reviewed based on industrial classification, it is found that the IC associated investment has made dramatic progress in recent years. This signifies that analysis of the behaviors of investment into IC-associated facilities to identify what features they have will resolve many problems about the investment trend of the electronics industry. As a matter of fact, the IC-associated investment has been extended even to the raw material process industry, as well as the process/assembly industry in recent years, thus playing the leading role in the high technology industry. When viewed on a price basis, electronics-associated investment shares less than 90 percent of the entire investment. This clearly indicates that high technology is equal to electronics. Since the high technology industry mainly covers "fickle and small type" products, interim input such as raw materials and components are small and affects inflation and other fields less. Therefore, the high technology industry is said to have less spreading effects to other industrial fields. However, process innovation in the raw material type industry is carried out on a 10-15 year cycle. On the other hand, the high technology industry features product innovation, whose cycle is very short. (For example, the product innovation for IC's is carried out on a 3-4 year cycle.) When the fast investment rotation of the high technology industry together with the spreading effects upon technical problems are considered, it cannot be said that the substantial induced effects are not necessarily low. It is rather considered that the high technology industry will play the leading role to promote economic growth in the future.

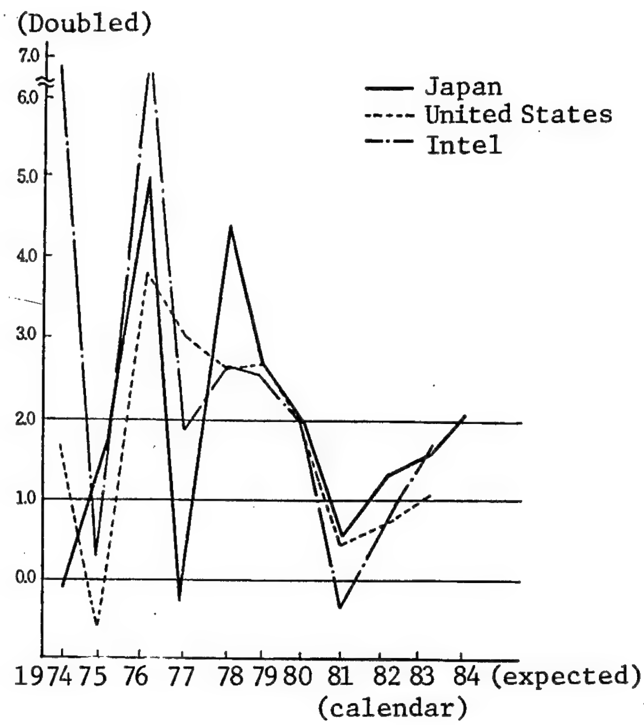


Figure 6. Ratio of Japan and U.S. Investment Efficiency

Table 8. Japan's IC Sales Amount and R&D Plant Investment

(Unit: Y100 million)

FY	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
IC sales (A)	862	834	1,082	1,649	1,555	2,519	3,749	5,477	6,181	8,026	11,444	19,608
R&D expenditure (B)	170	185	215	243	245	380	548	690	922	1,246	1,621	2,164
Ⓑ/Ⓐ = ①	(19.7)	(22.2)	(19.9)	(14.7)	(15.7)	(15.1)	(14.6)	(12.7)	(14.9)	(15.5)	(14.1)	(11.0)
Plant investment (C)	189	176	114	352	220	459	841	1,369	1,554	2,233	3,853	7,012
(Ⓒ/Ⓐ) = ②	(21.9)	(21.1)	(10.5)	(21.3)	(14.1)	(18.2)	(22.4)	(25.0)	(25.1)	(27.8)	(33.7)	(35.8)
① + ②	41.6	43.3	30.4	36.0	29.8	33.3	37.0	37.7	40.0	43.3	47.8	46.8

(Note) 12 companies are included as investigation targets by the Ministry of International Trade and Industry.

Table 9. Four U.S. Manufacturers' Sales Total and R&D/Plant Investment (On a four-company basis)

(Unit: $1 million)

FY	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Sales of four companies Ⓐ	2,889	3,286	3,052	3,714	4,564	5,664	7,321	9,009	9,441	10,116	11,240
R&D expenditure (B)	200	240	185	220	266	328	436	565	660	754	894
(Ⓑ/Ⓐ) = ①	(6.9)	(7.3)	(6.1)	(5.9)	(5.8)	(5.8)	(6.0)	(6.3)	(7.0)	(7.5)	(7.9)
Plant investment (C)	232	323	173	281	419	613	876	1,135	1,018	1,032	1,188
(Ⓒ/Ⓐ) = ②	(8.0)	(9.8)	(5.7)	(7.6)	(9.2)	(10.8)	(12.0)	(12.6)	(10.8)	(10.2)	(10.6)
① + ②	14.9	17.1	11.8	13.5	15.0	16.6	18.0	18.9	17.8	17.7	18.5

(Note) The four U.S. manufacturers include TI, Motorola, Intel, and NS.
(Data) Compustat

(3) Investment structure of the IC industry

The characteristics of the investment structure of the IC industry may be summarized in two points:

(a) Technical-oriented profile of the investment structure as the high technique

(b) Plant industry-oriented profile of the investment structure which is in pursuit of mass production

The technical profile described in paragraph (a) reveals that the product characteristics possessed by IC's (the substitutes of IC's are high functional products as well) call for high-speed technical development, cover a wide range of problems, and demand a huge sum of money for research and development. The profile described in paragraph (b) reveals that the establishment of mass production prior to other companies is essential and hence demands for huge investment as the higher functions are attained.

To identify the actual conditions of investment behavior prevailing in the IC industry more clearly, this investigation uses the following two indexes and hence compares the difference between Japan's behavior and U.S. behavior.

Table 10. Ratio of Sales Increases in the Current Year to Plant Investment in the Previous Year

Calendar year	Japan	United States	(Intel)
1974	Δ0.1	1.7	(7.5)
1975	1.4	Δ0.7	(0.2)
1976	5.0	3.8	(8.1)
1977	Δ0.3	3.0	(1.8)
1978	4.4	2.6	(2.6)
1979	2.7	2.7	(2.5)
1980	2.1	1.9	(2.0)
1981	0.5	0.4	(Δ0.4)
1982	1.2	0.7	(0.7)
1983	1.5	1.1	(1.6)
1984 (expected)	2.1		

Table 11. Investment Ratio of Japan (the average of 12 companies)

Year	R&D expenditure	Plant investment	Total
1974	21.5	20.4	41.9
1975	25.8	13.7	39.5
1976	22.5	32.5	55.0
1977	14.9	13.3	28.2
1978	24.4	29.5	53.9
1979	21.8	33.4	55.2
1980	18.4	36.5	54.9
1981	16.8	28.4	45.2
1982	20.2	36.1	56.3
1983	20.2	48.0	68.2
1984 (expected	18.9	61.3	80.2

Figure 12. Investment Ratio of the United States (the average of four companies) (Sales ratio to the previous year)

Year	R&D expenditure	Plant investment	Total
1974	8.3	11.2	19.5
1975	5.6	5.3	10.9
1976	7.2	9.2	16.4
1977	7.2	11.3	18.5
1978	7.2	13.4	20.6
1979	7.7	15.5	23.2
1980	7.7	15.5	23.2
1981	7.3	11.3	18.6
1982	8.0	10.9	18.9
1983	8.8	11.7	20.5

(Note) The level of the four companies is relatively low, but the substantial level is expected to rise to a large extent because the business ratio is high.

Table 13. Intel's Investment Ratio (Sales ratio to the previous year)

Year	R&D expenditure	Plant investment	Total
1974	16.7	19.7	36.4
1975	11.2	8.2	19.4
1976	15.3	23.4	38.7
1977	12.4	19.9	32.3
1978	14.5	36.7	51.2
1979	16.8	24.3	41.1
1980	14.5	22.9	37.4
1981	13.6	18.0	31.6
1982	16.6	17.5	34.1
1983	15.8	16.1	31.9

(a) Efficiency of investment: This stands for the scale factor of equipment investment in the previous year to sales increase in the previous year.

(6) Rate of investment: This identifies what percentage of the sales in the previous year is allotted to research and development investment and equipment investment in the next year.

Both Japan and the United States were subjected to repeated business fluctuations up to 1978 as "Efficiency of Investment" in Table 10 and "Comparison Between Japan and U.S. Investment Efficiency" in Figure 6 clearly indicates. After 1978, however, both Japan and the United States have kept the same level of investment efficiency or have been inclined to drop the level. The drop in the efficiency of investment means that the ever-growing huge equipment investment is producing the plant industry, including the prior investment into the next models which claim higher functions. In recent years (1983 and 1984), both Japan and the United States seem to have enjoyed the effects of mass production by reducing the average unit price irrespective of their keen plant investment competition in 256K DRAM.

When the investment rate in (b) is reviewed, it is found that the research and development rate in both Japan and the United States indicates a stronger technical orientation of the IC industry. The equipment investment in the United States was rather sluggish, while the investment in Japan rose dramatically, indicating a sharp contrast.

From the above analysis, the structural problems of the IC industry may be summarized:

The leading manufacturers in Japan are mostly centered on the side business of the major electronic companies. Therefore, it is needless to say that the analysis may be applied to the entire electronics industry.

i) Since technical innovation intensifies, and new products having better cost performances are introduced into the market, constant investment must

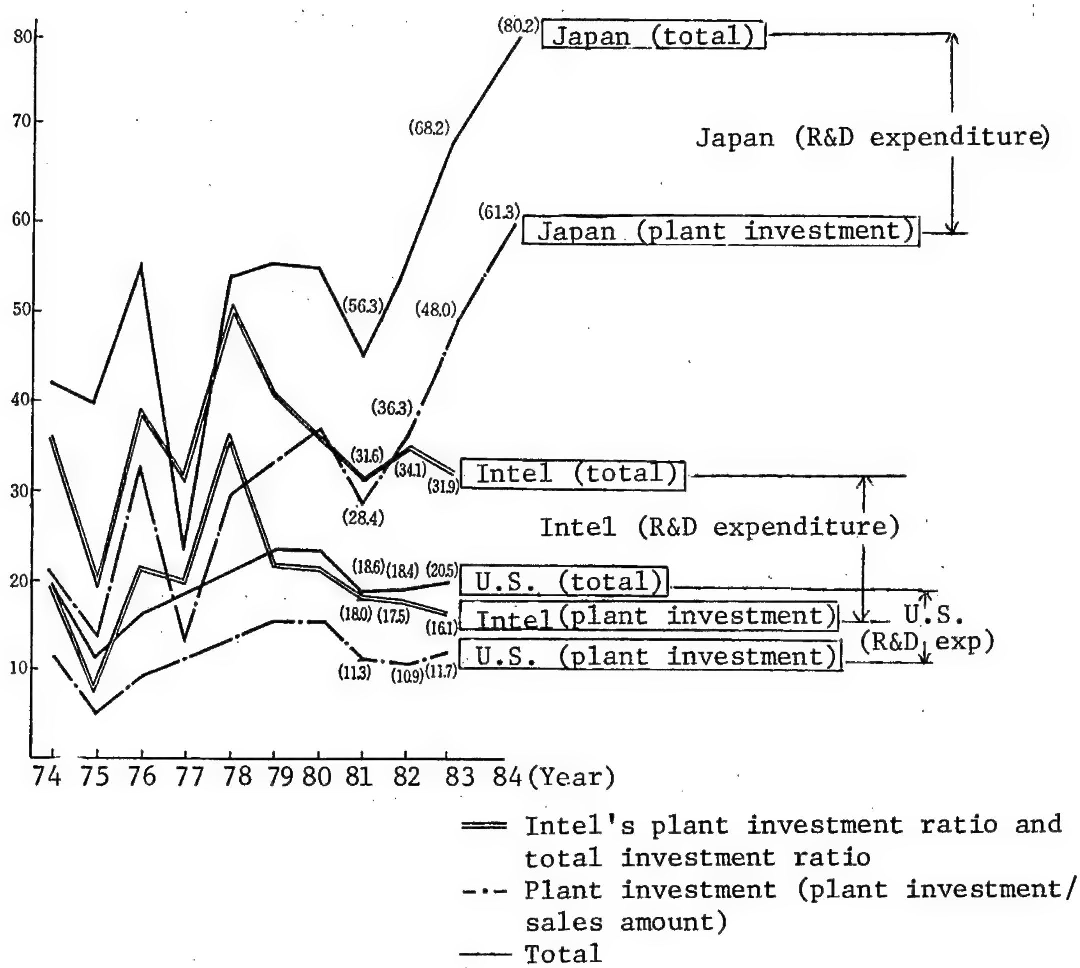


Figure 7. Japan and U.S. Investment Ratio

be made. Furthermore, state-of-the-art IC products stand on the extended line of the previous product innovation. Without technical accumulation, however, it is virtually impossible to enter the keen competition field of high technology industry.

ii) A great expenditure of money is required to research and develop one product from basic study up to mass production.

iii) No company can enjoy the preceding interest, unless the leading research and development and mass production technique are established prior to his competitors, which results in a marked gap between enterprises.

iv) Coupled with the high integration of IC products, the need for the introduction of more cost-consuming and higher performance facilities is increased, thus strengthening the trend of capital intensity. This signifies that the revulsion of capital over a short period of time should be the precondition, where the efficiency of investment is forced to drop, while a short-term redemption must be carried out with a profit maintained.

If demand becomes dull there exists a strong potential that a keen cost competition will be carried on. An enterprise which can enjoy the scale merit can survive from this keen competition, thus accelerating the trend of oligopolistic system.

v) Considering that a great expenditure of money is required for research and development with huge investment, an all-out power, including a strong fundraising power determines the success of an enterprise in this keen competition.

vi) Even when converted into an equipment industry, this does not mean the manufacture of a simple function product, but a constant and parallel pursuit for high-valued products. Therefore, the conventional investment behavior toward the steelmaking and petrochemical industries is not helpful for reference. In this sense, the electronics industry should be defined as an entirely new conceptual industry.

(4) Software

Coupled with the higher functions of IC's, the technical focus is changed from "how to fabricate" into "what functions to integrate." To determine the required functions, the supplier should realize the need of the user at first, which produces some background for the unification of both the supplier and the user. It is the software that can apply the user's needs. This creates the importance of software. As the process technique advances, the design engineer pays less attention to the process technique, approaches software, and tries to compete for additional values in this respect. This signifies that the importance of software is expected to be more and more highlighted. Therefore, every possible effort should be made to accelerate the application of software development, to reduce the development cost, and to promptly rearrange the background for improving product quality.

(5) Supply structure

The electronics industry is beginning to gradually place more and more attention on industrial equipment from home electronic appliances. Coupled with the above trend, the supply system is also beginning to change its character. The conventional production system based on mass production is of construction with major division of labor with the finished product manufacturer at the top. It consists of a stratified and labor-divided organization having several subcontractor groups. This construction has created the most effective production system, which has made it possible to transfer the parts of the labor intensity process to lower organizations step-by-step.

However, when specific attention is turned from conventional mass production-oriented home electronic appliances to a multiproduct and small quantity production and marketing age, both production and supply structures should be subject to change, no matter what they might be. To comply with the above trend, the flexible production line and diversification of product functions are required. A typical example refers to the introduction of NC

machine tools and industrial robots or the like. The advance of the electronic technique has made it possible to shift the conventional technique on the production site to the new technique based on multiproduct and small quantity production. In addition, the progress of raw material techniques, such as IC's, has enabled many functions to be replaced with integrated circuits. As a result, the product functions are fractionalized. This has enabled their completion as one element. The development of integrated circuits demands higher technology, including the associated production processes. Since a huge investment is required for research and development, the advance of overall electric equipment manufacturers or communications equipment manufacturers who have accumulated excellent technical know-how or can research and develop new technology is highlighted. In this manner, the progress of IC technique urges change in the quality of assembling industry-oriented production systems by introducing the plant industry-oriented industry which is quite different from the conventional part industry. In the meantime, the development of information is expected to bring about a marked change in the production system. More specifically, that change promotes the structural innovation of the electronics industry from the conventional pyramid-type, stratified, and labor-divided structure, to a network-type and labor-divided structure.

Under the network structure, a company can participate in a production project based on the individual desire of the company, and need not be affiliated with a specific enterprise unlike conventional business practice. Instead, more attention is placed on aggressive management activities, and hence information competition power acquires greater importance to gain every possible business advantage. From the viewpoint of satisfying a specific function, functional competition power must be improved.

1.3 The Internationalization of Japan's Electronics Industry

(1) The electronics industry in Japan started with the introduction of technical know-how from Europe, but Japan rapidly caught up with the Western manufacturers by improving both practical application and production technique. As for home electronic equipment, Japan solidified its position as a supply base in the world in the 1960's, and established itself as the kingdom of home electric equipment. In like manner, Japan enjoyed a favorable balance of trade for semiconductors, starting with 1980. As for computers, a similar favorable balance of trade was attained from 1981.

(2) The status of onsite production

The outward direct investment balance for electric machinery at the end of 1984 amounted to $2,824,000,000, and ranks next to the steelmaking nonferrous, and chemical industries. As for the area classification, direct investment in North America amounted to $1,509,000,000 (53 percent), thus predominantly leading other areas. Starting with 1978, outward direct investment was dramatically switched from the Southeast Asian countries to the Western countries. This is because the onsite manufacture of capital-intensive products, such as color television sets and semiconductors, has

flourished remarkably in North America. In the beginning, local production in the less-developed countries was very active and popular, because the local cost was low and a good quality labor force was available as well. However, due to the recent rise in labor costs, many of the advantages of local production are fast being lost. On the other hand, local production in the advanced countries is mainly intended to respond to the "protectionism" movement. As a matter of fact, local production in the advanced countries has become very popular since 1980 to comply with the protectionism movement.

(3) Trade flow for local production

Table 14. Japanese Corporation Customers According to Area Classification (electric machinery)

(Unit: Y1 million)

Customers \ Local production country	North America	Central and South America	Asia	Middle East	Europe	Oceania	Africa
North America	757,831	195	102,252	0	57	0	0
Central and South America	4,572	205,193	11,919	0	0	0	0
Asia	0	145	452,845	0	4,143	0	0
Middle East	0	0	6,675	5,244	0	0	0
Europe	242	217	32,484	0	65,945	0	0
Oceania	7	7	3,698	0	0	66,889	0
Africa	0	5	3,337	0	0	0	17,238
Japan	2,966	40	118,871	0	590	0	0

(Note) Investigated as of the end of March 1981 or at the nearest account time.
Originated from "Basic Investigation of Overseas Business Activities" prepared by the Ministry of International Trade and Industry

Table 14 clearly indicates that almost all locally manufactured products are sold in the local areas where they are manufactured. However, 38 percent of locally manufactured products in Asia are sold to a third market (including 16 percent for Japan). This has heightened the fact that the Asian countries are just beginning to become the second export base for Japan. They make a great many purchases from Japan as well. On the other hand, locally manufactured products in North America are mostly sold in the region. This is partly because the local market is extensive in scale, but chiefly because local production has been promoted from the standpoint of maintaining the current market share. According to Table 15, which shows the suppliers for the local cooperation per area classification, it is found that the greater part of products are still purchased form Japan, thereby compensating to some extent for the reduction in export from Japan.

Table 15. Japanese Corporation Suppliers According to Area Classification (electric machinery)

(Unit: Yl million)

Customers \ Local production country	North America	Central and South America	Asia	Middle East	Europe	Oceania	Africa
North America	100,745	1,928	1,352	0	700	0	0
Central and South America	1,200	54,343	0	0	17	0	0
Asia	33,075	250	223,984	0	47	0	0
Middle East	0	0	0	2,087	0	0	0
Europe	3	34	1,255	0	17,865	3,070	209
Oceania	0	0	37	0	0	5,992	0
Africa	0	0	0	0	0	0	1,687
Japan	343,129	40,132	192,846	1,237	16,312	37,646	10,163

(Note) Investigated as of the end of March 1981 or at the nearest account time.

Originated from "Basic Investigation of the Overseas Business Activities" prepared by the Ministry of International Trade and Industry

The international cooperation in terms of marketing is also very active. In particular, OEM (original equipment manufacturing) cooperation has markedly developed. This business practice offers high merit to Japanese manufacturers, since they can expect the effects of mass production and at the same time they can make the most use of OEM as a complementary marketing route in the local areas. International cooperation is carried out over all business aspects, including technical and marketing fields. It may be said that the Japanese electronics industry is playing the leading role in this respect.

(4) When the outlook for the future international environment is reviewed, it can be seen that the advanced countries will heighten their "protectionism" posture more and more in high technology industry in particular.

On the other hand, they are apparently keenly interested in the technical transfer to less-developed countries. Considering these factors, the electronics industry in Japan should make every possible effort to improve the technical level (especially basic techniques), and lead the international cooperation favorable to Japan in terms of both technical and marketing cooperation with attention to international cooperation. This is a great task that both the Japanese Government and Japanese private enterprise should carry out.

2. The Outlook for the Electronics Industry

In this section, the report discusses the role of the electronics industry in the high information society, or the outlook for the role the electronics industry is required to play in the future. To begin with, the impact the high information society will have on the economic organization will be identified, and then the role the electronics industry should play will be discussed in this context.

The following four viewpoints will be cited when analyzing the high information society:

(1) The cost of social joint capital and the reform in its quality.

(2) The reform cited in (1) may change the conditions an enterprise takes part in or withdraws from, thereby forcing a great change on the individual strategy of an enterprise.

(3) The reform on the supply side cited in (1) and (2) will develop the service economy and accelerate the transfer from the current economic pattern into the selective consumption pattern based on the accompanying small volume multiproduct manufacturing system.

(4) Mutual penetration of planning and price mechanism

The improvement in the quality of social joint capital will naturally have a great impact on national products. The electronics industry is expected to play the leading role by innovating the infrastructure based on an extended information network. It is up to technological innovation in the field of electronics which covers terminal equipment whether or not the handling of the network can be facilitated. In addition, a drop in cost will affect its popularity. This signifies that although involved in the keen competitive world of private enterprise, the electronics industry must play the decisive role in determining the quality and level of social joint capital.

Furthermore, information itself is not only the center of production and exchange, but also plays the leading role in contributing to the activation of the industrial organization by reducing the cost of the system which conveys information as a medium (or by increasing the potential to divert the plant system). In this respect, electronics is playing the leading role.

As Japan's society is more and more information-oriented, the need of consumers displays the aspect of individuality, and hence prompts the trend of multiproduct and small-volume manufacture. However, it is inevitable that the cost becomes exceptionally high. Electronics engineering has a great possibility to drastically change the basic concept of multiproduct and small-volume manufacture. This change in the basic concept is highly expected to create a new consumption system and activate the entire economic performance.

A technical revolution in electronics is currently bringing about a fundamental change in the design philosophy of the conventional communication system. Electronics has improved "divisibility" inside the system and successfully converted a decentralized system into a very effective one. Such changes have accelerated the progress of "deregulation" in the communication system.

3. The Electronics Industries of Foreign Countries

In this section, the report investigates the electronics industries in 1) Europe and America, 2) Southeast Asia, 3) Central and South America, and 4) the socialist countries. In this investigation, specific attention is placed on the pursuit of newly industrializing countries, and detailed onsite investigation was carried out to report the current status of the electronics industries in South Korea, Taiwan, Hong Kong, and Singapore. (There is a separately prepared investigation team report.) As for the detailed information about NICS, please refer to the text of the committee report since space is limited.

20136/9365
CSO: 4306/507

JANUARY'S NUCLEAR POWER GENERATION FACILITY USAGE RATE DISCLOSED

Tokyo GENSHIRYOKU SANGYO SHIMBUN in Japanese 6 Feb 86 p 8

[Excerpt] January 1986atomic power plant operating statistics (including "Fugen") show an 81.8 percent rate of facilities utilization, with a time utilization rate of 83.1 percent. This again exceeds the previous month's facilities utilization rate of 80.2 percent, which had been the highest recorded since the beginning of 1985. A facilities utilization rate at the 80 percent level for 2 consecutive months was achieved last year in November and December. Facilities utilization exceeding 70 percent has been maintained for 19 consecutive months since July 1984.

The reason for favorable operations in January was that a total of five reactors including Mihama 1 of Kansai Electric Power Company were brought into the competition, one after another. Incidentally, during January the Japan Atomic Power Company's Tokai No 2 station, Tokyo Electric Power Company's Fukushima No 1 generator 3, Chubu Electric Power Company's Hamaoka No 1 generator and Chugoku Electric Power Company's Shimane station each began scheduled inspections, bringing the total number of generators undergoing scheduled inspection to seven.

If the facilities utilization rate is considered by type of reactor, the 16 BWR [boiling water reactor] reactors (12.917 million kW total output) averaged 72.7 percent, and the 15 PWR reactors (11.438 million kW total output) averaged 92.6 percent.

By power company, the rates were 72.7 percent for Tokyo Electric Power Company (9.096 million kW), 89.1 percent for Kansai Electric Power Company (7.408 million kW) and 98.8 percent for Kyushu Electric Power Company (2.898 million kW).

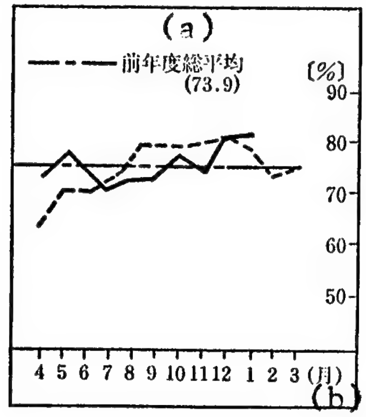
Then, the new convertor reactor station "Fugen" was put into operation 21 December 1984 and was being operated at rated output, but on 13 January a small accumulation of water was discovered on the floor under the reactor coolant cleaning system pipes in the first basement steam pipe room of the turbine building. When insulating material was removed and the pipes inspected, a minute steam leak near a weld was confirmed. Operation of the reactor was therefore suspended, and the cause is being investigated at present.

[Definitions in boxed item at end of article]

Facilities utilization rate equals generated power divided by the product of authorized output and calendar hours.

Time utilization rate equals hours of operation divided by chronological hours.

Figure 1 Average facilities utilization rate (broken line is fiscal 1984)



key: (a) FY1984 overall average (73.9%)
(b) Month [April 1985 to March 1986]

Figure 2 Facilities utilization rate by reactor type

	(a) 基数	(b) 出力(万KW)	(c) 設備利用率(%)
BWR	16	1,291.7	72.7
PWR	15	1,143.8	92.6
GCR	1	16.6	84.0
ATR	1	16.5	40.5
(d) 合計	33	2,468.6	81.8

Key: (a) Number of reactors
(b) Output (10,000 KW)
(c) Facilities utilization rate (%)
(d) Total

Figure 3 Facilities utilization rate by power company

	会社名 (a)	基数 (b)	出力(万KW) (c)	設備利用率(%) (d)
e)	日本原子力発電	3	162.3	71.7
f)	東北	1	52.4	100
g)	東京	10	909.6	72.7
h)	中部	2	138.0	80.3
i)	関西	9	740.8	89.1
j)	中国	1	46.0	27.3
k)	四国	2	113.2	100
l)	九州	4	289.8	98.8
m)	(ふげん)	(1)	(16.5)	(40.5)

Key:
- (a) Company name
- (b) Number of reactors
- (c) Output (10,000 KW)
- (d) Facilities utilization rate (%)
- (e) Japan Atomic Power Company
- (f) Tohoku Electric Power Company
- (g) Tokyo Electric Power Company
- (h) Chubu Electric Power Company
- (i) Kansai Electric Power Company
- (j) Chugoku Electric Power Company
- (k) Shikoku Electric Power Company
- (l) Kyushu Electric Power Company
- (m) (Fugen)

Figure 4 Atomic power station operations bulletin (GENSHIRYOKU SANGYO SHIMBUN survey)

	(a) 発電所名	(b) 型式	(c) 認可出力 (万KW)	(d) 時間稼働率 (e) 稼働時間 (H)	(%)	(f) 設備利用率 (g) 発電電力量 (MWH)	(%)	(h) 備考
i)	東海	GCR	16.6	744	100	103,704	84.0	
j)	東海第二	BWR	110.0	456	61.3	497,865	60.8	第7回定検開始(1.20) (aa)
k)	敦賀1	〃	35.7	744	100	264,689	99.7	
l)	女川	〃	52.4	744	100	389,856	100	
m)	福島第一·1	〃	46.0	744	100	342,240	100	
	〃 2	〃	78.4	0	0	0	0	第8回定検中(60.9.6~) (bb)
	〃 3	〃	78.4	216	29.0	165,864	28.4	第8回定検開始(1.10) (cc)
	〃 4	〃	78.4	744	100	583,296	100	
	〃 5	〃	78.4	744	100	571,639	98.0	
	〃 6	〃	110.0	744	100	814,000	99.5	
n)	福島第二·1	〃	110.0	0	0	0	0	第3回定検中(60.11.21~) (dd)
	〃 2	〃	110.0	744	100	818,400	100	
	〃 3	〃	110.0	744	100	818,400	100	
o)	柏崎·刈羽1	〃	110.0	744	100	804,420	98.3	
p)	浜岡1	〃	54.0	414	55.6	199,960	49.8	第8回定検開始(1.18) (ee)
	〃 2	〃	84.0	744	100	624,845	100	
q)	美浜1	PWR	34.0	744	100	247,712	97.9	
	〃 2	〃	50.0	744	100	371,635	99.9	
	〃 3	〃	82.6	744	100	599,043	97.5	
r)	高浜1	〃	82.6	744	100	614,458	100	
	〃 2	〃	82.6	744	100	614,458	100	
	〃 3	〃	87.0	199	26.7	120,524	18.6	第1回定検中(60.11.6~)(1.23併入) (ff)
	〃 4	〃	87.0	744	100	631,000	97.5	
s)	大飯1	〃	117.5	744	100	864,700	98.9	
	〃 2	〃	117.5	744	100	845,455	96.7	
t)	島根	BWR	46.0	205	27.6	93,513	27.3	第11回定検開始(1.9~) (gg)
u)	伊方1	PWR	56.6	744	100	420,917	100	
	〃 2	〃	56.6	744	100	420,938	100	
v)	玄海1	〃	55.9	744	100	415,656	99.9	
	〃 2	〃	55.9	744	100	390,584	93.9	
w)	川内1	〃	89.0	744	100	661,780	99.9	
	〃 2	〃	89.0	744	100	662,062	100	
x)	小計または平均 (カッコ内は前月)		2,452.1 (2,452.1)	20,090 (19,934)	84.4 (83.7)	14,973,613 (14,704,806)	82.1 (80.6)	
y)	ふげん	ATR	16.5	310	41.6	49,717	40.5	(hh) 原子炉冷却材浄化系配管からの漏洩による原子炉手動停止(1.13~)
z)	合計または平均 (カッコ内は前月)		2,468.6 (2,468.6)	20,400 (20,192)	83.1 (82.2)	15,023,330 (14,731,311)	81.8 (80.2)	

[key on following page]

Key:
(a) Power station name
(b) Reactor type
(c) Authorized output (10,000 KW)
(d) Time utilization rate
(e) Hours of operation (H)
(f) Facilities utilization rate
(g) Generated power
(h) Comments
(i) Tokai
(j) Tokai No. 2
(k) Tsuruga
(l) Onnagawa
(m) Fukushima No. 1
(n) Fukushima No. 2
(o) Kashiwazaki-Kariwa
(p) Hamaoka
(q) Mihama
(r) Takahama
(s) Oi
(t) Shimane
(u) Ikata
(v) Genkai
(w) Kawauchi
(x) Subtotal or average (previous month in parentheses)
(y) (Fugen)
(z) Total or average (previous month in parentheses)
(aa) Began 7th scheduled inspection (20 Jan)
(bb) Undergoing 8th scheduled inspection (6 Sep 85)
(cc) Began 8th scheduled inspection (10 Jan)
(dd) Undergoing 3rd scheduled inspection (21 Nov 85)
(ee) Began 8th scheduled inspection (13 Jan)
(ff) Undergoing 3rd scheduled inspection (6 Nov 85 to 23 Jan 86)
(gg) Began 11th scheduled inspection (9 Jan)
(hh) Reactor operation suspended (13 Jan) because of leak from reactor coolant cleaning system pipes

9601
CSO:4306/2045

SOCIETY FOR SCIENCE POLICY, RESEARCH MANAGEMENT ESTABLISHED

Tokyo KOGYO GIJUTSU in Japanese Jan 86 pp 27-30

[Text] 1. Introduction

A general meeting held on 31 October 1985 formally organized and established a new research society, the Japan Society for Science Policy and Research Management. The purpose and goal of this organization is to conduct academic research on putting emphasis and priority on planning, and use it as the focal point in coordinating or promoting research and development, and to facilitate an exchange of information on research.

The "priority on planning" refers to those broadly described as the R&D managers; those individuals who draw up plans and coordinate the research and development activities and supervise, manage and administer the various steps and stages involved in research and development. It does not include the researchers and technicians performing the scientific or technological research and development. This category of R&D managers includes those at the national government level who administer and supervise science and technology activities and also the supervisory personnel of research and development activities carried out at business corporations and research entities. This society will handle both science policy (also called research policy) and R&D management in its scope of activities instead of considering them separately, as is done by similar research societies in Europe and the United States.

The birth of this organization is significant because it provides a forum where systematic and organized academic discussion will be held concerning the direction to take, and how to manage science and technology activities.

2. Background Leading to Establishment of Society

For some time, researchers at universities and think tanks have continued to express a desire for a forum to be established to provide a place where research activities can be announced. A condition conducive to the smooth organization of such a society existed if someone would make a serious effort to undertake it. A rare opportunity for this sprouted during a certain research project, and with Takashi Mukaibo and Keiichi Oshima, both professors emeritus, Tokyo University spearheading the effort, a group of sponsors held a preparatory meeting in November 1983. After approximately 1 year of groundwork the committee of organizers held the first meeting in December of

1984. The initial number of people in the organizing group were six from universities, two from think tanks and six from the national government.

Subsequently, the organizers met once a month, more or less to consider and deliberate on such things as the makeup and scope of activity of the society, coordination with other societies with a common interest. They approached and had discussions with the people expected to be candidates for the various offices of the society, and completed a draft of the bylaws of the organization. These activities were followed up by a public announcement in September soliciting membership in the society and finally it was possible, as mentioned earlier, to hold a general meeting to organize and establish this society on 31 October.

Meanwhile there were replacements and additions in the organizing group and its membership mushroomed to also include representatives from seven national government entities; the Science and Technology Agency, Ministry of International Trade & Industry, Ministry of Education, Ministry of Agriculture, Forestry & Fisheries, Ministry of Construction, Ministry of Transport and Ministry of Posts & Telecommunications. The membership in this society, as of November, counting only membership applications received, totals 100 corporate organizations and 180 individuals.

3. Reasons for Need to Have Society

The organizing committee also analyzed the various factors listed below. The factors which mandate that society needs this organization are as follows:

One. Efforts are being expended to systematize science and technology because of its growing influence on the economic community, and in-depth efforts are being expended in new frontiers in science and technology to ensure they are in harmony with human society. In view of this situation, there is a need to have a deeper understanding of science and technology, as well as the relationship it has with human society.

Two. There is a desire to have our nation engage in creative technological development to achieve advancement and progress not only of our contry's economy and society, but also to contribute to the benefit of the international community. In order to be able to initiate an independent concept and delve into areas of science and technology that are yet untapped, there is an increased necessity to have a strategy for research and development and a need to implement a planned research and development program.

Three. Reforms and improvements in production were quickly accomplished in production aspects of factory operations after World War II, and measures are now being taken principally in clerical and administrative aspects to step up production efficiency. In contrast, there was little or no attention to production in research and development activities, and consequently, there is a strong demand now for action to make it logical and rational.

Four. A significant number of valuable and useful projects based on originality of data, concept, method and in-depth examination exist in some

projects conducted at think tanks, universities, business corporations and the government. The time is ripe to establish a forum in Japan to make available a place where useful projects can be systematically integrated and announced instead of being isolated and confined to a single sector of activity.

4. Description and Activities of Society

(1) Field of Academic Pursuits of the Society

This society will be known as The Japan Society for Science Policy and Research Management, and as adumbrated by its name, the scope of interest of this society are the various sectors related to science and technology and also to research and development management.

In Europe and the United States, science policy (or research policy) and R&D management are pursued separately and deemed as two distinct fields of academic efforts. This society, however, will handle both aspects. The reason for engaging in both aspects are as follows:

One. All of the research is in "science and technology" and "stages in research and development" and is interrelated .

Two. The same standard of "priority on policy" is used to measure the benefits and achievements of research.

Three. The subject of research is, on the one hand, problems of national government or those on an international level and, on the other hand, problems of an organization or individual. However, in our judgement there is positive significance in separating the problem into different categories and relating the micro and macro aspects and handling them in the same arena instead of dealing with matters separately.

(2) Plan of Activities of Society

The following activities were decided and scheduled for the initial fiscal year at the general meeting:

One. Publication of Society Journal

The society will publish the JOURNAL OF SCIENCE POLICY AND RESEARCH MANAGEMENT twice during the fiscal year but the plan is to increase it to six publications per annum contingent on the growth and development of the society.

The plan is to print a composite of research thesis (primary information) and commentary (secondary information) in the journal. It is also planned to emphasize publishing high quality information in the journal and make it a special characteristic of the publication. An example of categories to be published in the journal is indicated in Table 1.

Table 1 Example of Table of Contents of Journal

Category	Theme
Preface	Special Article "Productivity of Research and Development"
Introduction	General Analysis of Scope and Makeup of Interdisciplinary Research
Research Thesis	Technological structuralization based on Katsumuki Graph Theory
Research Notes	Special analysis of New Product Development band on case studies
Commentary	Makeup of Knowledge and Productivity of Intelligence
Group Lecture	Facets of R&D Management
Lecture	Method to Evaluate and Assess Social System
Prospectus	New Frontiers in Technology
News	Concept of Tokyo Bay Causeway
Introduction of Foreign Publication	Advanced Technology in the European Community
Abstract of Significant Reports	Report on Investigation of Molecular Electronics
Data Bank	Computer Circuit on R&D Literature

Book Review/Overseas News/Forum by Society Members/News of Society

Two. Annual Science Convention

A science convention for the purpose of providing a forum, the same as that available and provided in the society's regular meeting, will be held once every year. The first science convention is scheduled to be held in the autumn of 1986.

Three. Seminary (Symposium)

In addition to the autumn science convention primarily focused on announcement of research activity, in the spring there will be a seminar or symposium on overall subjects of interest. The seminar probably will be on a specific theme. The first seminar will be held around May.

Four. Organizing Subcommittees and Holding Subcommittee Meetings

Subcommittees will be formed to conduct in-depth studies of specific fields of research and each subcommittee will meet several times during the fiscal year. At present, the society's board member responsible for operations is heading a task force to study and determine how to operate and exercise administration over subcommittees including what should be the policy of the society in forming subcommittees.

Since this is the society's initial fiscal year, the first thing to complete is coordination and finalization of the organizational structure of this forum, and as of November, the society members who support and assist in performing the administrative duties and responsibilities; members who do the editing and printing and those responsible for business operations, were assigned their duties.

(3) Probable Members of the Society

It is expected that researchers or research and development project officers listed below (Table 2) will join the society and participate in its activities.

One. Research Specialists

Research specialists in sectors of research conducted by this society who were referred to above, are primarily responsible in furnishing and making available the seeds of research to this society. Let us identify them and the organizations they belong to.

Table 2 Estimated Number of People Connected With Society

	Researchers by Type of Relationship They Have With Sector of Research Performed by Society		
Type Organization	Specialist	Interested	Associated
Dentistry	30	200	-
Think Tank	150	1,500	5,800
Administrative Organs	20	150	-
Research Organs	20	200	1,900
Business Corporations	100	2,000	13,000
Total:	320	5,050	-

a. Researchers at Universities: At the present time there are few research specialists in the above fields at the universities. However, in many instances an academic course or a course for specialists focused on interdisciplinary soft science, includes the areas of research performed by

this society, as one sector and segment of such courses. Examples are: a course on policy and science research in the graduate program at Saitama University, engineering course at the Tokyo Institute of Technology, Tsukuba University's course in plans and management, and the expanded general culture research course No 2, Basic Education Division, Education Department of Tokyo University.

In addition, there are researchers engaged in other academic disciplines but interested in these fields. They are primarily with the economic and engineering departments, and the total in this category is more than the number of research specialists. This large group includes those from traditional sectors of engineering as well as those in management engineering, mathematical planning, operations research, systems analysis, organizational science, social psychology, science history and fundamental science.

There are probably 30 research specialists at the universities in the professional fields listed above. However, even researchers in peripherally related fields of research, participate in council meetings or are present when delegated to do research, and the planners of research activity deem these researchers to be affiliated with the investigation and research in progress, and by cumulative count they total 200 or more people.

b. Researchers at Think Tanks: Government and private sector think tanks in Japan total 300 organizations and a staff of 5,800 researchers. Even if 1/4th of these researchers have an interest in sectors of science and technology related to their field of research, they represent a total of 1,500. However, probably only 10 percent of them (150) are currently active researchers. This society believes that other researchers in this group are potential members of this society.

Two. Coordinator and Negotiator of Plans and Programs

The second category of researchers are those who participate in research activities, and who are the beneficiaries of the accomplishments and achievements of this society's research program. They may in some instances engage as needed in actual investigation and research or in the development of technology. It is regrettable, however, that in many instances many in this group change their field of interest as a result of being assigned to different positions.

a. Administrators: These include professional personnel in science and technology who administer science and technology programs and activities in the national government and its agencies, and the plans and programs officers in the prefectural and municipal governments and public organizations assigned and charged with the responsibility of drafting and coordinating plans to bring improvement and progress to their area of jurisdiction. The national government has trained and developed approximately 20 professional researchers and the number of professional researchers is increasing at a rapid pace. In addition, there are probably between 100 to 150 potential researchers who are interested in working in this field.

b. Researchers in Research Entities and Business Corporations: According to a poll of the manufacturing industry, 45 percent in this industry in Japan replied that in their view the appropriate number of supervisory personnel needed to administer and operate research and development in their organization is between 6 percent and 10 percent of the total personnel who administer and operate the research and development program. If this percentage is used and applied to the total of 31,980 researchers in private research institutions and 223,882 in business corporations, the appropriate number of supervisory personnel is approximately 15,000. It is believed that this number of supervisory personnel should be used as the yardstick in calculating the number of supervisory personnel in research and development who have some sort of relationship with this society. Even if 10 percent or 20 percent of this supervisory group is interested in the activities of this society, it is a significant number of people.

Let us look at the same number of supervisory personnel from the standpoint of plans and programs officers charged with the responsibility of drafting and coordinating plans (similar to the duties performed by officials of research and development headquarters) of an organization's strategy on research and development. There are approximately 1,000 enterprises, mostly those in the manufacturing industry, listed in the Tokyo Stock Exchange as business entities emphasizing research and development activities. Assuming that the number of personnel responsible for coordinating plans and programs is 2 or 3 times more than the number of organizations, in this case 2,000 to 3,000 are in this category, and this figure is close to the estimate of the appropriate number of supervisory personnel pointed out in the preceding paragraph. This group is the core of personnel responsible for management and operation of research and development who no doubt have keen interest in this society's programs and activities.

If many professional research specialists are developed from a forum made up of many different types of organizations, the research and development activities in Japan will be more meaningful and significant. It is a blessing if this society by its activities contributes to achieving that goal.

5. Conclusion

Let us discuss some of the opinions made during the general meeting which established this society.

President Takashi Mukaibo pointed out that the activities of this society should be carried out on the basis that they are international in scope, and Vice President Noboru Makino said that strategy and planning are important to those performing scientific technological activities in Japan. Vice President Keiichi Oshima, during a panel discussion pointed out the importance of measurements in soft science and Shogo Itakura, technical councillor, Agency of Industrial Science and Technology, MITI and one of the key figures who labored to organize this society, emphasized that research should be based on facts.

It is believed that the mission and duty of this society is to compare, on an academic level, the universal opinions and values concerning research and

technology, to furnish information analyzed objectively, and to provide steps on the ways and means of obtaining information to make proper judgements and decisions on the various phases involved in research and development. It is expected that as indicated by these gentlemen, if there is increased understanding of the things pointed out, it will pave the way for a new and pure academic prospect emerging in science and technology.

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NEC'S TELECOMMUNICATIONS EQUIPMENT STRATEGIES DESCRIBED

Tokyo TOSHI KEIZAI in Japanese Feb 86 pp 74-76

[Text] The telecommunications equipment business, leader in the C&C (computer and communications) field, is expanding rapidly from microwave communications systems and satellite earth stations to the optoelectronic and optical communications sector, and is maintaining a high annual growth rate of 20 percent.

High-speed facsimilie transmission, high-speed data communications, teleconferencing, "Captain" (videotext information service), satellite television broadcasting -- rapid progress is being made in putting such diverse information transmission systems to practical use. It is truly the golden age of electronics.

In the midst of this, Nippon Electric Co., Ltd. (NEC), which can be called the "dragon child" of the "new media" era, is faced with the ordeal of a semiconductor market slump, but it is maintaining a high growth rate because of its performance in the strong, strategic C&C business. In particular, the telecommunications equipment business, which is NEC's specialty, has strengthened NEC's ability to survive as it enters the era of application of private communications satellites, optical communications and digital communications.

Computers, a 20 Percent Growth Rate Industry

C&C is a target of NEC's management, and the settlement of accounts for the first half of this fiscal year was a tacit answer that clearly showed the results of that strategy.

Most of the major electrical equipment manufacturers had lower profits because they suffered direct hits from the semiconductor market slump and the appreciation of the yen. NEC, however, with recurring profits of Y60,075 million (less taxes, Y32,075 million), showed a profit increase of 13 percent (39 percent) over the same period of the preceding year. Even rival company Fujitsu, Ltd., showed a 36 percent reduction in profits, and as a result, its ability to withstand recession, as well as its profit-making and growth capabilities, will be reviewed.

Several of NEC's strong points underwrote the increased profits. A direct cause of the business slump suffered by electrical equipment manufacturers was stagnation in the semiconductor market. Price cuts in the memory device sector

were particularly steep, but this accounted for only 30 percent of NEC's semiconductor business (the average for other companies was slightly under 50 percent). Furthermore, NEC produced a wide range of devices and was able to shift production. Additionally, unlike other companies, NEC produces semiconductors through its subsidiaries, so the burden of large-scale investments are not reflected in the parent company's settlement of accounts.

However, the real reason for NEC's remarkable ability to withstand recessions lies beyond the "flexibility" of its device production business. It lies in its high-growth capability in the C&C field. In the settlement of accounts for the first half of the year, its growth rate in both computers and telecommunications equipment was 19 percent above the same period of the preceding year.

In the computer field, the 20 percent increase in sales of OA (office automation) related small-scale equipment, such as office computers and personal computers, was outstanding. The growth in the field of personal computers for business use, of which NEC enjoys a monopolistic share of 70 percent, was a major source of support for the company.

As a result, if one looks at the composition of computers on the basis of CPU (central processing units), NEC's production of computers has become balanced, with 40 percent in large-scale computers and 30 percent each in medium and small-scale computers. Thus, NEC can respond easily to changing needs in the market and it can maintain a growth pattern that does not fluctuate widely. Incidentally, NEC's computer sales (including the value-added portion of exports and rentals converted to sales price) for the first half-year period was Y360 billion, a 25 percent increase in revenue over the same period of the preceding year, and since it expects sales to be Y810 billion for this fiscal year, it will have a very high growth rate of 22 percent on an annual basis. This can be viewed as a success of NEC's carefully thought-out strategy for the small computer market in anticipation of the advent of the OA era. Moreover, in today's era of information network communications services, in which efficient information handling is being sought by networking various kinds of computer systems, the balancing of computer types is an important force.

NEC's Forte, the Communications Equipment Industry

Needless to say, NEC's leadership in the communications industry also supports its C&C strategy. However, this encompasses a broad field which includes microwave communications equipment, earth stations for satellite communications, optoelectronics and optical communications. Even in the company's present midterm settlement of accounts, sales in the communications equipment sector came to Y344.6 billion, a 19 percent increase over the same period of the preceding year. This is as favorable as the company's performance in the computer industry. In the latter half of the fiscal year, sales have increased, especially in the optoelectronics sector, and on an annual basis, it is expected to reach Y705.0 billion, a 15 percent increase over the preceding year.

On the verge of entering the golden age of electronics, the strength of the communications equipment industry promises high growth to fulfill the enormous needs of the market in three sectors -- microwave communications equipment, communications satellite earth stations and optoelectronics.

NEC's wireless sector (microwave communications, earth stations) comprises 45 percent of its communications equipment business. In both of these sectors, the company is in the top level of the world market and holds 28 percent of the free market. The company in second place, AT&T, holds 25 percent, and in the free market, the gap is widening in terms of technological as well as research and development capability.

Microwave communications could be said to be the base technology of NEC's communications equipment business. With the radar technology and know-how developed before and during World War II as the base, NEC developed microwave communications after the war as telecommunications for peaceful use. NEC systems are highly trusted and already have been delivered to 80 countries. It is said that the company handles 5,700 earth stations. In recent years, the developing countries of Southeast Asia and the Middle East have been coming up with a constant flow of communications infrastructure policies, and because of this tremendous demand, the growth rate of over 10 percent probably will continue.

Responding to the Communications Satellite Era

Unlike the computer business, the communications equipment business is haunted by the difficulty of anticipating the needs of the rapidly changing communications service era and of following it in detail. In recent years, demand in the communications equipment market has been dominated by communications services which have grown out of satellite communications. At the same time, optical and digital communications techniques are starting to be introduced and in fact are almost at the stage of being put to practical use.

Thus far, NEC has prided itself in being the world's best in communications satellite earth stations in terms of technical capability and actual delivery. It handles about 50 percent of the earth stations which are members of Intelsat (a global commercial telecommunications satellite system). Orders for such earth stations will expand, but the approach the company is most interested in right now is communications satellites which are being developed at a private level.

In the United States, IBM already has jointly established a satellite communications firm, SBS (Satellite Business Service), which has provided communications services since 1981. In Japan, actual moves in this direction finally have begun to emerge.

At present, three groups have formed new companies. Japan Communications Satellite, which will introduce a communications satellite manufactured by the Hughes Corporation of the United States, was formed by Mitsui and Company and C. Itoh and Company. Space Communications, which is planning to introduce a communications satellite manufactured by Ford Aerospace Communications

Company of the United States, was formed by the Mitsubishi Corporation and Mitsubishi Electric Company of the Mitsubishi Group. Finally, Sony Corporation from the home electronics industry, is expected to form Satellite Japan with RCA of the United States. Japan Communications Satellite and Space Communications already have received approval and are preparing to launch Japan's first private communications satellites in 1987-88.

Once the communications satellites are realized, comprehensive digital communications services, including high-speed facsimile transmission, high-speed data transmission, and telephone and television conferencing, will become possible. This will provide the most effective services in terms of office automation.

Naturally, a tremendous demand will be created for communications-related terminal equipment for building networks which will tie into these communications satellites. It is said that with the launching of each group's communications satellite, there will be a demand for 2,000-3,000 earth stations alone. As a result, competition will become fierce among communications equipment and general electrical equipment manufacturers. Already Toshiba, which was defeated by NEC for the position of chief contractor for the next broadcast satellite planned by the National Space Development Agency, is aiming at a rollback and has entered the market for small-scale earth stations that use the KU-bank (11-14 gigahertz frequency band).

It is said that Matsushita Electric Industrial Company, Ltd., also plans to enter this sector in affiliation with the Harris Company of the United States. In the midst of this competition, which involves newcomers as well, there are signs that NEC, the market leader, is quickly moving to establish an engineering service company with the Japan Communications Satellite group.

Since NEC already has a substantial performance record for small-scale earth stations, it wants to capitalize on being in the vanguard. In fact, NEC has delivered a total of 100 earth stations to the aforementioned SBC [as published]. Recently, NEC successfully concluded a deal with Federal Express, an express delivery service company of the United States, for a Y100 billion, high-volume order of facsimile equipment and for 5,000 small-scale antennas for its satellite communications service.

Entry Into Next Broadcast Satellite Sector As Well

In the domestic communications satellite market as well, NEC would like orders for earth stations, in affiliation with Japan Communication Satellite, to lead to high-volume orders for various types of equipment, such as signal multiplexers, which are part of network structures.

However, there are sectors in which NEC has not made inroads; namely, the Japan Space Development Agency's broadcast and communications satellites.

Thus far, the agency has launched about 20 scientific, weather, broadcast and communications satellites. NEC has been receiving contracts not only for scientific and weather satellites, but for broadcast and communications

satellites, the "key stations" of the new media era, the chief contractors, Toshiba and Mitsubishi Electric, consistently have been in charge of follow-on equipment. The pattern has been NEC for weather satellites, Toshiba for broadcast satellites and Mitsubishi Electric for communications satellite. However, NEC has been acknowledged by all to be the world leader in communications equipment, so it was very aggravating that it was not handling the most promising sectors of the era, those of communications and broadcast satellites.

That is why NEC challenged Mitsubishi Electric for the role of chief contractor for the next communications satellite, CS-3. Ultimately, NEC failed to capture the communications satellite role, but its tenacity paid off and it got the role of chief contractor for the broadcast satellite.

This broadcast satellite will be the second in the series which will be in actual use. Although the satellite bus will be manufactured by the Hughes Corporation, the communications system itself, from the transponders to the antenna and earth stations, is precisely the sector in which NEC specializes, so it has acquired a platform upon which to realize fully its potential in general electronics and communications technology.

Approach to the Optical Communications Era

Another sector of the communications equipment business which has hidden growth potential is the optoelectronic and optical communications field. Domestically, NTT is working on a plan for an information network system (INS) which will convert the national communications network from the present electrical communications to optical communications in the 1980's and 1990's.

Underlying this plan is the fact that electrical communications no longer can handle today's rapidly increasing volume or the qualitative changes -- from voice and alphanumeric letters to the transmission of computer data, pictures and graphics -- in communications.

Unlike electrical communications, however, optical communications require a relatively complex system. Analog systems are sufficient for voice and electrical wave modulation. However, optical communications are based on digital systems, so these must be various kinds of conversion functions. Moreover, the efficiency of the optical fiber cable which is used as the transmission path becomes more important. The efficiency of an optical fiber cable is determined by the distance which it can transmit light.

NEC, with free use of its semiconductor and laser technology, has achieved a non-relay record of 14 kilometers using a 1.5 micron laser beam (generated by laser diode), albeit on an experimental basis. Naturally, this is a world record. NEC's receipts in the optical communications sector came to Y60 billion for this fiscal year, which already accounts for 10 percent of the communications equipment business. It is quite possible that this will be a sector which will have even greater growth capability than microwave systems and satellite earth station systems in the future. Promising commercial products presumably will continue to be developed, from the INS trunkline to local area networks (LAN) or cable television (CATV), and then to such products as the optical disk memory device for data processing, which applies optical techniques.

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